

# **O.C.S. OVERSIGHT OF 1978 AMENDMENTS—PART 3**

---

**HEARINGS**  
**BEFORE THE**  
**SELECT COMMITTEE ON THE OUTER**  
**CONTINENTAL SHELF**  
**HOUSE OF REPRESENTATIVES**  
**NINETY-SIXTH CONGRESS**  
**FIRST SESSION**  
**ON**  
**OVERSIGHT ON THE**  
**OUTER CONTINENTAL SHELF LANDS ACT**  
**AMENDMENTS OF 1978**

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**JULY 9, 23, AUGUST 1, SEPTEMBER 17, 1979, WASHINGTON, D.C.**  
**AUGUST 29, 30, 1979—SAN FRANCISCO, CALIF.**

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**the Outer Continental Shelf**





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*pt. 3*

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(II)

<sup>1</sup> Resigned Oct. 23, 1979.



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# OUTER CONTINENTAL SHELF OVERSIGHT HEARING

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THURSDAY, AUGUST 30, 1979

HOUSE OF REPRESENTATIVES,  
SELECT COMMITTEE ON THE OUTER CONTINENTAL SHELF,  
*Washington, D.C.*

The select committee met, pursuant to adjournment, at 11:30 a.m., in the Red Barn, Point Reyes National Seashore and Wilderness Area, San Francisco, Calif., Hon. William J. Hughes (acting chairman) presiding.

Present: Representatives Hughes, Burton, Miller, Lewis, McCloskey and Royer.

Staff present: Carl L. Perian, chief of staff; Lawrence J. O'Brien, Jr., chief counsel; C. Grady Drago, minority chief counsel; Tom Tackaberry, professional staff member; Kate Bonner, research assistant.

Mr. HUGHES. I am Congressman Bill Hughes, from New Jersey. I will be chairing the meeting today.

At this point, if you all take seats, we will begin taking testimony.

Today we commence our second day of field hearings on the central and northern California lease sale No. 53.

Once again, I would like to thank Congressman John Burton and his staff for their assistance in bringing this hearing to Point Reyes. A brief tour of the Point Reyes National Seashore only reaffirms the appropriateness of the amendment accepted by the Congress to ban OCS activities within 15 miles of this environmentally sensitive area.

With the memory of the trauma of the Santa Barbara oilspill still in mind and with the scenes of the record-size Bay of Camche oilspill still in the press, it is understandable why OCS activity off California is a volatile issue. The OCS Committee has come to California to examine firsthand all of the issues surrounding the controversial lease sale No. 53, some of which are unique to California, and some of which are generic to the OCS leasing program and OCS development.

Yesterday the committee conducted a hearing in San Francisco on sale No., 53. Testimony was received from Interior Department officials, State government witnesses, various county supervisors, and industry representatives. I feel that yesterday's session was constructive. It served as a forum for State and local officials to voice their concerns over the sale, and for Interior Department and industry representatives to address those concerns.

The hearing gave the committee a wide range of views to consider. Many would undoubtedly have the sale canceled outright; others urge that the lease process be delayed until vital environmental studies are completed, and still others believe that in light of our critical energy situation and successful OCS development elsewhere, the sale should proceed on schedule.

Earlier in the year, one Bureau of Land Management official pessimistically remarked regarding sale No. 53, "I guarantee you no matter what we decide to do, we will be sued." It is my hope that these hearings will help to develop a greater understanding of the problems associated with sale No. 53, and the measures which are being taken—and perhaps those additional measures that should be undertaken—to address those problems. Hopefully, an accommodation on the sale can be achieved.

Briefly, I will relate some of the testimony we have heard to date.

The State of California has recommended to the Secretary of the Interior that sale No. 53, scheduled for May 1981, be dropped from the proposed 5-year leasing program, and that any sale offshore central and northern California be delayed until 1984 to allow the State more time to prepare for development. The position of the Interior Department is that the decision on the composition of the 5-year program is not final, and that sale No. 53 should be maintained on schedule so that the necessary leasing procedures can be completed, leading up to the secretarial decision on whether to go ahead with the sale.

Opponents of the sale argue that not enough environmental baseline data is available to proceed with it at this point, and that the results of a number of scientific studies either underway or planned will not be completed in time to be factored into the EIS and the leasing decision. It is the opinion of the Interior Department that sufficient environmental information will be available, as needed, to plan for and make leasing decisions.

DOI points out that contract "deliverables" or environmental studies include progress reports, draft reports and other submissions containing the information necessary to complete the draft environmental report by April 1980, as planned; and that report in turn will be made available to the public.

It is argued that the resource potential is not significant enough to justify the associated risks. Industry and DOI suggest that past hydrocarbon shows indicate the presence of oil and gas but the extent will not be determined until drilling operations are conducted. They add that a 30- to 50-day supply, if encountered, would not be insignificant.

Opponents of the sale point out that the sale area may yield so-called sour crude, which would aggravate the west coast "oil glut." Although the State is investigating the feasibility of retrofitting refineries to handle sour crude, such facility modifications would prove costly. Industry and DOI argue that some of the lease area is thought to contain gas and that the sulfur content of any oil in the area cannot be predetermined. Small oil finds could be handled, they say, and large finds would make retrofitting economical. Finally, it is argued that the west coast "oil glut" is a transportation problem that can and will be solved.



Next, DOI contends that OCS air quality impacts, if significant, will be curtailed by regulations promulgated pursuant to the 1978 OCS amendments.

When severe weather conditions in the lease area are cited as a reason not to proceed with the sale, DOI and industry point to successful OCS development in the stormy North Sea and the hurricane-prone Gulf of Mexico.

In light of recent and past earthquakes in the San Francisco area, there is a natural concern that such geohazards could cause damaging oil spills. To this argument DOI and industry assert that no greater seismic risk is present than elsewhere, such as Santa Barbara and in Alaska's Cook Inlet. They assure us that extensive site-specific geohazard studies are required and that installations, built to withstand severe conditions, will not be allowed in unsafe locations.

A major tenet of the 1978 OCS amendments is to enhance State and local participation in OCS decisionmaking. DOI maintains that this policy is being carried out vigorously, pointing to numerous local meetings and extensive consideration of State comments. Industry argues the fact that only 1.3 million acres are being studied for leasing out of some 8.4 million acres nominated is proof that the negative nomination process is working. Still there are complaints that State and local concerns have not been given meaningful consideration.

Today we will continue to examine these and other aspects of sale No. 53, as we hear from an environmental panel, county supervisors, and fishing interests.

At this time, John Burton, do you have any opening remarks that you would like to make?

Mr. BURTON. Well, I would like to repeat everything I said yesterday, and then some. If everything works out right, within 10 years we will probably get 30 days' supply of gasoline and oil, and I do not think the threat to the ecology of northern California is worth such a gamble. And this one Member of Congress—and it is very courageous to say this in West Marin—is going to do everything that he can to see that these leases are not let.

The industry's testimony yesterday was very unsatisfactory. They glossed over some very serious problems. And the group of witnesses that you have here today and the turnout that you have here today is, I think, testimony to the concern of the people, not only in West Marin, but throughout the whole North Bay, as to what they want their land to be like and what they want the State to be like when their children's children are alive.

Mr. HUGHES. Mr. Lewis.

Mr. LEWIS. Thank you, Mr. Chairman. I have no formal remarks but I would like to express my appreciation for you and the chairman of our committee as well for bringing the committee to California, which is my home State, and thank John Burton as well as Don Clausen for their efforts to put our meetings together.

I come from southern California, where as a young boy it was always a great pleasure to enjoy the mountains which surround what is beautiful San Bernardino Valley. And today I look at that valley, where one spends a lifetime hoping to build a house on the side of the hill, and you cannot see the mountains two blocks away

because of the fact that some years ago we ignored the significance of population growth and expansion and a lack of planning in terms of preserving our environment.

It is perhaps most significant that this committee was willing to take this bus ride today to see this beautiful territory, for it has to be obvious that the map is different than the territory.

I personally believe the committee is committed to making certain that as we look at one of those elements that leads to solving our energy problems in this country, that they will hold for most in their mind the fundamental importance of preserving territories such as this, which obviously are irreplaceable.

It is nice to be here. I am sure it will be a productive session.

Mr. HUGHES. Thank you.

Before we introduce the panel, I would like to take just a few minutes to thank the Marin County Conservation League. They were responsible for our bus trip here today. They are providing lunch for us. We had an absolutely fascinating tour of the area this morning, to see some of the grandeur of California. We are deeply appreciative to members of the league, particularly to Supervisor Giacomini, our host supervisor, Mr. Hendman on the board of directors, Margaret Gill, Sally Wilson, and Susan Stom, Mr. Lynn Thompson, who is superintendent of the Golden Gate National Recreation Area; Cathy Reed, and Margie Goodman, all of the Marin Conservation League.

I also want to again repeat we appreciate the efforts of John Burton and his staff, who have made our visit to California most successful.

I happen to represent the Atlantic City, N.J., area. I have roughly 80 miles of Atlantic coastline, all of Delaware Bay, and quite a bit of the Delaware River. In my district I have either under construction or in place six nuclear powerplants. Every one in the State of New Jersey is in my district. Offshore oil and gas developments is taking place off our shores. The ocean dumping you read about often is right off of my beaches.

When they studied the area recently, to bury toxic waste, they identified some areas in my district for that particular purpose. So I can understand your great concern over OCS development in your area. And we are just happy that we could bring the OCS Committee here today, so that we can listen to you and your concerns, and hopefully reach the kind of accommodation that Chairman Murphy indicated he hopes likewise can come about as a result of these hearings.

We have a number of committee staff. Don Clausen testified before our committee yesterday. And he has staff people here, as do other Members of Congress, both on the committee and not on the committee, who have staff people represented here today, and we thank them for joining with us.

At this time I would like to introduce our first panel, an environmental panel. First, former State Senator Peter Behr. We are happy to have you with us, Senator. Dr. Michael Herz, Mr. Nelson Wolfe, Mr. Richard Charter, Mrs. Susanna Jacob, who is chairman of the Environmental Action Committee of West Marin. We are happy to have all of you with us this morning.

**ENVIRONMENTAL PANEL: PETER BEHR, FORMER STATE SENATOR, MARIN CONSERVATION LEAGUE BOARD OF DIRECTORS, INVERNESS, CALIF.; DR. MICHAEL HERZ, EXECUTIVE VICE PRESIDENT, OCEANIC SOCIETY, SANTA CRUZ, CALIF.; NELSON WOLFE, SAVE OUR SHORES, SANTA CRUZ, CALIF.; RICHARD CHARTER, FRIENDS OF THE COAST, BODEGA BAY, CALIF.; AND SUSANNA JACOB, CHAIRMAN, ENVIRONMENTAL ACTION COMMITTEE OF WEST MARIN, POINT REYES STATION, CALIF.**

Mr. HUGHES. We have your statements in full. Without objection, they will become part of the record.

Why don't we start with you, Senator Behr, if you would. Perhaps you can point out those highlights of your testimony so we can perhaps begin to ask the questions of the entire panel. What I would ask you to do is summarize your statement. After all the panel members have testified, then we will open it up for questions.

#### STATEMENT OF PETER BEHR

Mr. BEHR. Thank you, Mr. Chairman and Congressman Burton and my friend Mr. Lewis as well. You really deserve our gratitude for coming to the very roots of the grass roots of Marin County. In doing so, I believe you are performing a very responsible act. Perhaps our testimony may be a bit repetitive, but in the end it will have some wheat in it as well as chaff.

So we are grateful for your coming, particularly grateful for the key role that this committee played in the enactment of the Outer Continental Shelf Lands Act Amendments of 1978.

I will be testifying for the Marin Conservation League, which recognizes that exploration and development of the Outer Continental Shelf for oil and gas has been national policy since 1953. And it furthermore recognizes that one of the important purposes of your amendments of 1978 was to expedite exploration and development on the Outer Continental Shelf as a partial, but what is deemed to be a necessary, step toward achieving national energy independence.

But we have concerns which we trust you will not assume to be simply legalistic, that the Secretary is not properly interpreting the constraints of your amendments of last year. I would like to quote briefly from section 18 and 3 of the amendments, which we understand to be the heartland of what Congress intends in terms of selecting the time and location of leasing by the Secretary; namely, to achieve a proper balance between the potential for environmental damage, the potential for the discovery of oil and gas—and in addition the potential for adverse impact on the coastal zone.

We turn briefly to the Interior Department program document, and find out that how we interpret this seems to be quite different from the understanding of Interior. Interior says:

We do not believe it was the intent of Congress to permanently exclude areas from consideration with the exception of the area within 15 miles of the boundaries of the Point Reyes Wilderness.

We have therefore treated the factors to be considered in preparing a leasing program as issues which need to be addressed—

And this I think is important—

Whether during the pre- or post-sale planning process, rather than possible impediments to comprehensive planning for leasing.

The question of scheduling for possible lease sale a particular area which has hydrocarbon potential is not whether, but when, and what actions need to be taken in order to ensure the other resource values of the Outer Continental Shelf and the marine, coastal and human environments are protected.

Now, we believe this interpretation—and we will quote from the Secretary very briefly to further our point—was not the intention of Congress; namely, that by excluding some one area from consideration, all other areas of the Continental Shelf, not just off the Pacific coast, but off all our States, would automatically be fair game, should hydrocarbon potential be established.

To further evidence this erroneous interpretation, we have a letter from Secretary Andrus dated June 25 of this year, to Governor Brown, in which he inclosed the proposed 5-year program for exploration and development off our coast, and said:

Further, the OCS Lands Act as amended provides the legal framework to insure that oil and gas exploration and development can be conducted safely in all areas of the United States.

This reinforces what we believe to be a misinterpretation by Interior. In addition, in regard to Lease Sale 48 in southern California, we find Secretary Andrus saying that, "It would not directly affect the California coastal zone, and therefore would not require a consistency determination with the State's coastal management program," which, as this committee knows, was approved in 1978 by the Secretary of Commerce.

All of this is troublesome and leads us to look a little further to be sure our interpretation of what is intended by your amendments is correct.

We need only look at the preceding section 18(a)(2), which lists the eight considerations which the Secretary must take into consideration, and includes among others an equitable sharing of developmental benefits and environmental risks among the various regions. It includes under (G) "the relative environmental sensitivity and marine productivity of different areas of the OCS"; and under (H) "Relevant environmental and predictive information for different areas of the Outer Continental Shelf."

Now, the Marin Conservation League takes no exception to an equitable sharing of risks among the various regions. But either through its zeal to be equitable, or to justify the selection of tracts based solely on their oil and gas potential, the Department of the Interior seems to be regarding all lease sale areas as interchangeable.

Let me skip by concerns about the funding of studies, and whether they will be available in time for the draft environmental statement. This will be covered by others.

But if there is additional proof for our concern over Interior's misinterpretation of congressional intent, it lies in the location of the 3,343 tracts which are included in lease sale 53.

First of all, they were selected despite negative nominations by everyone locally, from the State level down. They were selected because and only because they were high resource tracts, or so designated by USGS, and tracts which were nominated by the oil

companies. We believe many of them were selected without regard for their environmental or coastal impact.

Now, I don't have the time to go too deeply into the various tracts. But if I use the eight tracts just outside the 15-mile prescribed area from our Point Reyes Wilderness Area, I would suggest that they will be star examples of what we are discussing.

To begin with, and we are not arguing this as a legal point but one of interest, if you use 15 nautical miles instead of 15 statute miles in determining the radius within which no permits are permitted to be issued, you would take in four of these eight tracts.

To find any single area of more environmental sensitivity, or more importance to the people of this country, you would have to look far and wide.

For example, the Federal Government has an investment of \$60 million in the Point Reyes National Seashore. We have a 2 million annual visitor count there. Just to the south of the seashore, and covering all the ocean coastline of both Marin County and San Francisco, is the Golden Gate National Recreation Area, in which the Federal Government has invested \$70 million so far, and expects to invest another \$90 million for development within the next 10 years.

You have seen the area. It is unique. But it also is exceptionally fragile. The Farallon Islands, the largest rookery in any of the lower 48 States so far as nesting birds are concerned, are threatened by two areas, proposed for lease, one to the north, and one to the south. And the Farallons are being presently considered for Federal marine sanctuary status, one of three sanctuaries which are suggested for such possible designation along the entire California coast.

We have Tomales Bay, a 13-mile estuary, one of the two into which herring come to spawn, with very little flushing action. If oil is spilled and gets into Tomales Bay, it no doubt will stay there.

Nearby we have many much-used ocean beaches. We have significant commercial fisheries.

You have to regard the potential risk both to the coastal zone and to the environment generally, on the basis of what may be found in these eight tracts. If nothing is found, so be it. And that will end the risk. But if there is a development of oil justified by exploration, that this assumes a given basin will be subject to a significant development.

Now, we understand the BLM scenario for the Sonoma, Marin, and Mendocino tracts calls for tankering or barging any oil produced, adding a risk the State has officially declared unacceptable and creating the kind of air pollution which we find most troublesome in the bay area.

I would conclude by saying that the league emphasizes its understanding of the need to achieve national energy independence. It accepts the responsibility of California to share equitably with all other coastal regions, both the benefits and risks of drilling on the Outer Continental Shelf. But we want the developmental benefits and the environmental risks carefully measured in accordance with the factors which are required to be considered under your amendments of 1978.

We want the studies completed in a thorough manner with sufficient time within which to accomplish this, meaning time for the Secretary to study, time for the Governor to comment, and not having it an internal house document without the benefit of public scrutiny. This is required, as you know, by NEPA, and the authority of the Administrator of NEPA is preserved explicitly in your amendments.

Now, the Secretary is under great pressure. The Secretary is not an elected official. And the ability to act in accordance with his own best judgment has to be tempered with the attitude of the Administration. He said just 5 months ago: "I would say they"—I guess meaning like ourselves, or more important the people of California—

Have valid concerns and complaints about the potential damage of that sale, and which leases should be left out. There is the possibility that Sale 53 might be slipped in the schedule if it does not prove up. If it is disallowed, I would substitute in that time frame another sale, so the energy needs of America would not slip.

Consequently, the Secretary is sensitive to these concerns. But the way the department presently is interpreting your amendments, we have our own serious concerns which I am pleased to be able to voice for the league. Thank you, Mr. Chairman.

[The information follows:]

#### TESTIMONY BY SENATOR PETER BEHR

The purpose of my testimony on behalf of the Marin Conservation League will be to present what it believes to be convincing evidence that the Secretary of the Interior, so far as Lease Sale 53 is concerned, has failed to comply with the Outer Continental Shelf Lands Act Amendments of 1978, mandating what factors must be considered in selecting the timing and location of proposed lease sales on the Outer Continental Shelf.

We are grateful to you, Mr. Chairman, and to your Committee members for coming to California. We are equally grateful for the key role your committee played in the enactment of Public Law 95-372 last year.

The League recognizes that the exploration, development and production of oil and gas on our Outer Continental Shelf became national policy with the passage of the OCS Lands Act of August 7, 1953. It also recognizes one of the important purposes of the Amendments of 1978: namely, to expedite exploration and development of the Outer Continental Shelf as a partial but important step towards achieving national energy independence.

But the League also recognizes that these amendments provide a blueprint which the Secretary must follow in pursuing this national purpose; these are summarized succinctly in Section 18(a)(3) of the Amendments, as follows:

"The Secretary shall select the timing and location of leasing, to the maximum extent practicable, so as to obtain a proper balance between the potential for environmental damage, the potential for the discovery of oil and gas, and the potential for adverse impact on the coastal zone." (Sec. 18(a)(3), added by Sec. 208 of OCS Lands Act Amendments of 1978)

Proposed Lease Sale 53 is perhaps the best example of how this section has been virtually ignored by the Secretary, and how the Bureau of Land Management, having begun fulfilling the requirements of the 1953 Act as applied to Lease Sale 53, was unwilling or unable to adjust its process to accommodate to the new and unfamiliar requirements of the 1978 amendments.

First, what do we understand to be the clear meaning of the quoted section? We understand it to mean that certain areas of the Continental Shelf have higher potential for environmental damage—or lesser potential—than others.

Higher potential for the discovery of oil and gas—or lesser potential.

Higher potential for adverse impact on the coastal zone—or lesser potential.

We understand this section to mean that the Secretary is required to balance these potentials in selecting the timing and the location of leasing: that the risk of environmental damage could be too great to justify leasing in some locations, even assuming a high potential for the discovery of oil and gas; or that the adverse

impact on the coastal zone could also be too great; that some areas of the Outer Continental Shelf are too valuable for other uses to justify their being leased pending improvement in offshore oil development technology.

Lease Sale 53 graphically illustrated why, despite this section, 800,000 acres off the Central and Northern California coast, covering five offshore basins selected from a frontier area of 10,742,183 acres comprising two-thirds of California coastline are scheduled for leasing May 1, 1981. It also illustrates why some of the blocks, clearly among the most environmentally sensitive along the entire coastline, have been kept in the proposed sale, despite protests and negative nominations. The reason is that Interior's program explicitly does not agree with our understanding of "proper balance" required by Section 18(a)(3). Instead Interior states:

"We do not believe \* \* \* it was the *intent of Congress to permanently exclude areas from consideration*, with the exception of the area within 15 miles of the boundaries of the Point Reyes Wilderness \* \* \* We have therefore treated the factors to be considered in preparing a leasing program as issues which need to be addressed, whether during the pre or *post-sale* planning process, rather than possible impediments to comprehensive planning for leasing. *The question of scheduling for possible lease sale a particular area which has hydrocarbon potential, is not whether, but when*, and what actions need to be taken in order to ensure the other resource values of the OCS and the marine, coastal and human environments are protected. (Emphasis added, Tab B, Interior Department Program Document.)

Implicit in Interior's program is the right to select the timing and location of leasing and strike a proper balance after the sale by laying conditions on how exploration and development may proceed, no matter how environmentally sensitive the lease area may be. It interprets the exclusion of the area within 15 miles of the boundaries of the Point Reyes Wilderness to mean that congress specifically intended the Secretary to exclude no other OCS area from leasing.

As stated in the June 25, 1979 letter of Secretary Andrus to Governor Brown, enclosing the proposed program for OCS oil and gas lease sales for the period March 1980 through February 1985.

"Further, the OCS Lands Act, as amended, provides the legal framework to ensure that oil and gas exploration and development can be conducted safely in *all* areas of the United States." (Emphasis added.)

That the Committee, when it drew up Section 18(a)(3) required the timing and location of leasing to include an assessment of the potential for environmental damage and adverse impact on the coastal zone before, not after the lease sale is made clear in the immediately preceding Section 18(a)(2), listing ten considerations on which the timing and location of lease sales shall be based. These include:

(B) An equitable sharing of developmental benefits and environmental risks among the various regions;

(G) The relative environmental sensitivity and marine productivity of different areas of the Outer Continental Shelf;

(H) Relevant environmental and predictive information for different areas of the Outer Continental Shelf.

The proposed schedule of the Secretary is not based on these factors at all, so far as Lease Sale 53 is concerned. We take no exception to an equitable sharing of risks among the various regions, but either through its zeal to be equitable, or to justify the selection of tracts based solely on their oil and gas potential, the Department of the Interior seems to be regarding all lease sale areas as interchangeable.

This may account in part for Lease Sale 53's being scheduled for leasing in May, 1981, despite the state's request that the sale be delayed so that studies funded by BLM may be included in the Draft Environmental Study. We are informed that The Marine Mammal and Seabird Survey, and the report on the ecological characterization of the Central and Northern California coast will not be ready in time for the DES. The assessment of geohazards will not be completed until the summer of 1980. The DES will contain only a preliminary report on geohazards, the Air Quality Modeling Study will be based only on inadequate existing data, according to state air pollution control officials. The contract for a Report on conflicts between the fishing industry and OCS activity is not yet awarded. Studies dealing with Shipping and Navigation conflicts and Recreation and Aesthetics usage for Northern California, have not been funded to date, though deemed necessary by BLM staff in its Pacific OCS office.

An August 10, 1979 memorandum from the California Coastal Commission commenting on Interior's proposed national leasing program contained this disturbing paragraph:

"There is conflicting information in the proposed program on studies under way for Northern and Central California. One section states that geohazards, pollutant

transport and socio-economic studies have been completed, with supporting characterizations finished on containment distributions, oceanographic hazards, living resources, and impact assessment. Both the Interior Department and the Pacific OCS Office of the Bureau of Land Management were puzzled when questioned as to the existence and status of these various studies."

If we step back for a moment and view the entire federal zone from which the 243 tracts in Lease Sale 53 have been selected, extending two-thirds of the length of California's coast, from the Oregon border to Santa Barbara, we find it to be ranked 16th of 22 in oil and gas potential by the geological survey in the context of the 22 OCS areas of the Atlantic, Gulf of Mexico, California, and Alaska regions.

It is agreed by all concerned that any oil recovered will be heavy crude with a high sulfur content, unable presently to be processed by California refineries. 500,000 barrels of similar Alaskan oils is now shipped daily through the Panama Canal to Gulf Coast and Eastern refineries. Because this type of oil is processed most economically into heating oil, it is not likely to replace imported foreign oil on the West coast. Even without Lease Sale 53 BLM estimates a 600,000 to 1.3 million barrel/day surplus of high sulfur crude on the West coast in 1985.

Perhaps the most disturbing aspect of Lease Sale 53 is the location of many of the 243 tracts included in the sale, which were selected because, and only because they were recommended as high resource tracts by USGS and nominated by the oil companies; they were selected without regard to their environmental or coastal impact.

USGS estimates the most probable recoveries from Lease Sale 53 will come to 548 million barrels of oil, about a 30-day national supply. However, the eight Marin-Sonoma tracts are estimated at eight million barrels of oil, a 10-hour national supply. The 30 Mendocino tracts are estimated to produce 25 million barrels of oil, a 32-hour national supply. The 30 Humboldt tracts are estimated to contain a 30-hour national supply of gas, and no oil at all.

Of course, this is the first tract selection. If oil is discovered in any of these tracts, others nearby will inevitably be leased and developed. It is necessary to balance the potential for environmental damage and adverse impact on the coastal zone with what is bound to happen in the physiographic region where a substantial discovery is made.

Regarding the eight tracts proposed for leasing off the Sonoma-Marine coast it seems contrary to the spirit, if not the letter of the law forbidding leasing within 15-miles of the Point Reyes National Seashore to cluster these eight tracts just outside and up-wind from the 15 mile line, and visible from the national wilderness area as well.

The federal government has already invested \$60 million in the Seashore and \$70 million in the Golden Gate National Recreation Area just to the South of it. Proposed development of these two areas, a combination of unspoiled shoreline and major recreation beaches, comprising over 100,000 acres, and running along the entire Marin and San Francisco ocean shorelines, is estimated at \$90 million over the next ten years.

Also threatened in the event of an oil spill in this area all the Farallon Islands. These islands and surrounding waters host the largest seabird rookeries in the United States outside Alaska and Hawaii. More than half of California's marine birds nest here. They are dependent on the highly productive waters surrounding the islands to feed their young. It is one of the three candidate sites offshore California for possible designation as federal marine sanctuaries.

Despite its excellent record in offshore drilling, the petroleum industry is not proved infallible. The results of the Santa Barbara blowout are still apparent in the tarred sands of Santa Barbara's beaches. The massive blowout in Mexico proves that the best equipment is not fail-safe, and that cleanup equipment cannot contain sizeable oil spills at sea.

Furthermore, BLM's scenario for the Sonoma-Marine and Mendocino tracts calls for tankering or barging any oil produced, adding a risk the state has officially declared unacceptable.

In conclusion, the Marin Conservation League emphasizes its understanding of the need to achieve national energy independence, and it accepts the responsibility of California to share equitably with all other coastal regions both the benefits and risks of drilling for oil and gas on California's Outer Continental Shelf; but the League wants the developmental benefits and the environmental risks carefully measured in accordance with the factors required to be considered under the "Outer Continental Shelf Lands Act Amendments of 1978." It wants the studies completed in a thorough manner, with sufficient time to do so, and time for the Secretary to study them and the Governor of California to comment on them.



For these and other reasons previously mentioned, we respectfully recommend that this Committee request the Secretary of the Interior to delay Lease Sale 53 and consolidate it with the 1984 California lease sale.

If the Secretary had had the guidance of the 1978 Amendments when Lease Sale 53 was first considered, we feel confident he would have agreed with us. As he was quoted as saying by the L.A. Times just five months ago:

"I would say they have valid concerns and complaints about the potential damage of that sale, and which leases should be left out. There is the possibility that Sale 53 might be slipped in the schedule if it does not prove up—and we think safe—at this point in time.

"If it is disallowed, I would substitute in that time frame another sale so that the energy needs of America wouldn't slip."

Mr. HUGHES. Thank you, Senator.

Dr. Michael J. Herz, executive vice president of the Oceanic Society. Dr. Herz.

#### STATEMENT OF DR. MICHAEL HERZ

Dr. HERZ. Thank you. I am Michael J. Herz, executive vice president of the Oceanic Society. I am a scientist by training, having done basic research and having taught at the University of California in San Francisco and now having turned to more applied and relevant problems in working with The Oceanic Society, which is a 60,000-member organization devoted to the wise management of our marine resources.

We have been working throughout our history to promote the acquisition of objective information on the oceans and to make sure that such information gets used in the decisionmaking process. We are very pleased to have this opportunity to bring to the attention of your committee our concerns with the manner in which the proposed development of the offshore oil and gas is developing.

In October of 1976 BLM sponsored a conference which was designed to elicit recommendations from the academic community, government agencies and private citizens regarding the type of information that should be collected prior to the leasing of tracts off the central and northern California coasts. In the report that resulted from this meeting, it was pointed out that a broad, comprehensive research approach is needed for this region because it is:

\* \* \* a frontier area in which little previous oil and gas development has been attempted and because the area is one of the most poorly studied regions of the Continental Shelf of the continental United States.

The report went on to recommend that:

\* \* \* a matter of paramount interest to insure appropriate pre-sale studies, and give environmental evaluation a positive thrust, is an early call for nominations of tracts by industry. This should be followed by adequate time for essential investigations prior to establishing a sale date.

Since the time of this conference, relatively little of the research recommended has been undertaken and it is our feeling that the BLM Environmental Studies program has only just begun to formulate some of the questions that must be asked prior to leasing any tracts in the lease sale No. 53 area.

You know the lease sale schedule, with the DEIS being called for in April of 1980. I don't have to go through NEPA requirements and some of the other things that many other people have mentioned.

I would like to talk a little bit about the status of the environmental studies—our perception, not so much about the due dates that were given yesterday by BLM at the briefing, but rather how the data will be used and whether really having something delivered at the 11th hour before the DEIS is due, provides adequate time to assess it and integrate it into the report.

It is also our understanding that BLM is going to attempt to have a preliminary draft of that DEIS in December of this year, and I don't see how a lot of the reports which are not due until December or January or February can be included in that draft. And I just think the schedule makes it very difficult. Let me go through a few of these studies and our perceptions on them.

### 1. *The marine mammal and sea bird survey of central and northern California*

Although some of the bird survey work has been completed, it is our understanding that much of the existing data on birds and mammals in these areas still remain in the files of the Point Reyes Observatory which maintains a full-time biological field station on Southeast Farallon Island, an ideal location for the continuous collection of such information since it is the only offshore island in the lease sale No. 53 area.

In addition, PRBO is the only source of data—also unanalyzed—on beached birds—bird mortality from all causes for the past 3 to 5 years—on much of the California coast—see insert. Since sea birds are perhaps the organisms most severely affected by oil, such baseline data are extremely important for the DEIS.

We are even more concerned about the marine mammal work. The California State Marine Mammal is the California gray whale which is one of the only whale species that has responded to protection by recovering to historic population levels after being whaled to near extinction in the early part of the century. We feel that its economic value is considerably greater today than it was during the days it was whaled, because the people who go out to look at whales provide a significant amount of income.

In fact, Dr. Roger Payne on the east coast has assembled a lot of information indicating that the worldwide income from natural history trips to view the whales and from oceanariums and aquariums with whales and dolphins, exceeds that which comes from whale products. So we are very concerned that whale data be collected and included in the DEIS.

It is our understanding that the contract for the marine mammal survey has not even been awarded yet. There is no way that that work can be done in less than a year, and it will probably take 15 to 18 months to complete. So that it cannot be included in the DEIS.

### 2. *Ecological characterization*

A Memorandum of Understanding between BLM and the Fish and Wildlife Service was signed in March for the conduct of this work. The DEIS requires an in-depth description of the environment involved in the proposed action and yet, although a draft report is due in early 1980, the final report will not be completed until several months after the DEIS is due.

There is a five-volume work contracted for by BLM which has reviewed a lot of the data. However, a number of people are very concerned about the quality of that work, because the reviewers lumped unpublished reports done by students with published papers. There was no distinction made and as a result the quality of that five-volume work is somewhat questionable—see insert.

### 3. *Air quality modeling study*

The BLM is planning to award this contract soon with a draft report due at the end of the year and a final report expected in early 1980. Since drilling, production, and refining phases of lease sale No. 53 activities will definitely have implications for the regional air quality maintenance plans, the results of those modeling studies are extremely important for inclusion in the DEIS in order to demonstrate compliance with the Clean Air Act and its amendments.

### 4. *Geohazards assessment*

This work is currently being conducted by the United States Geological Survey and although a preliminary report is due at the end of the year, more complete findings are not scheduled until the summer of 1980. Despite the problems which have been encountered in California in terms of potential and existing nuclear powerplants and future LNG terminals, this study was ranked 55th in importance by the national BLM staff and almost was not funded at all. It is hard to believe that an adequate DEIS can be prepared without a tract-by-tract analysis of geological hazards and their potential impact on offshore oil development, including the transport phase—especially by pipeline.

### 5. *Conflict of space and facilities utilization between the fishing industry and OCS activities*

This and the following one are national studies which will examine issues and questions regarding OCS impacts germane to the lease sale No. 53 area. The contract for this study is expected to be awarded within the next month or so with no information being available as to a report due date. However, because of the California fishing industry concern over competition for the already insufficient number of slips, over the potential for fishing gear damage on drilling equipment, and over the impact of oil on the edibility of fish, the information resulting from this study is of importance for the DEIS.

### 6. *Effects of OCS activities on marine mammals*

Although the Navy is currently engaged in some research on the effect of various types of sound on marine mammals, the contract for studies on the effects of oil on whales, porpoises, seals, sea lions, otters, et cetera, has still not been awarded. Since a number of marine mammal species are on the Threatened and Endangered Species Lists, and since little or no data exists on the effects of oil on these organisms, some of this information should be required in the DEIS. Adding to the already difficult task of performing meaningful physiological work on these organisms is the sometimes near

impossible task of obtaining research permits from the Marine Mammal Commission for studies of this nature.

### 7. *Additional BLM-proposed study topics*

In addition to those studies which are in progress or have been approved for funding, there are a number of others which the BLM staff have proposed for the fiscal years 1980 and 1981, and which may receive high enough priority ranking to be funded. Among those which appear important for the DEIS are the following: (a) Impacts on special biological areas and habitats including threatened and endangered species habitats; (b) Risk assessment of OCS oil and gas development impacts on Federal and State protected marine and coastal habitats adjacent to proposed sale No. 53 lease blocks; (c) Oil toxicity to indigenous fish, shellfish, sea birds, and marine mammals; (d) Analysis of social costs and benefits to coastal recreation and aesthetic resources relative to proposed OCS oil and gas development; (e) Geohazard assessments by lease sale blocks; and (f) Assessment and evaluation of commercial and sports fishing and navigation conflicts.

We are pleased with the change in direction represented by the titles of many of the proposed studies from the baseline approach toward fate and effects studies, a response to strong criticism by the National Academy of Sciences and the Government Accounting Office. However, fate and effects studies conducted in the lease sale No. 53 region must be undertaken soon to counteract the erroneous impression that oil has no deleterious effects on the marine environment. While some industry scientists such as Dr. Straughan, from whom we heard yesterday, would have us believe that the effects of the Santa Barbara spill, or for that matter, any spill, are minimal, limited to acute impacts—a matter of months—with no detectable long-term repercussions, there exists a substantial body of evidence indicating numerous instances of persistent, long-term effects.

To cite only a few examples, Dr. Jeannette Whipple of the National Marine Fisheries Service Tiburon Marine Lab, here in the Bay area has found many serious and persistent effects of chronic, low-level exposure to fish eggs by aromatic hydrocarbons—see papers included in insert at end of testimony. She suspects that some of these effects may produce genetic as well as physiologic changes. The work of Vandermeulen in Nova Scotia—"Journal of the Fisheries Research Board of Canada," 1978, 35 630-36 and 643-647. This is a special issue of the Journal which is devoted to the effects of oil on the marine environment—has indicated that exposure to Bunker C oil after a grounding and sinking resulted in greatly reduced number of clams, fewer mature adults, a 1- to 2-year lag in tissue growth, lowered shell growth, effects which persisted for as long as 6 years after the spill. Krebs and Burns—*ibid*, pages 648-9—as well as Sanders—*ibid*, pages 717-730— of Woods Hole Oceanographic Institution have found serious and persistent effects of a spill in West Falmouth, Mass., lasting up to 10 years. These impacts produced behavioral changes in crabs and worms which led to abnormal burrows being constructed, ultimately leading to high mortality rates during winters when the animals were unable to protect themselves from freezing temperatures. Finally, in the Eko-

fisk field of the North Sea, Farrington and Quinn have convincingly shown the effects of the first 4 years of oil drilling on a frontier area after first having done very careful baseline monitoring. Their work reflects the gradually widening effect of production on benthic communities, animal tissues, and sediment.

Our concern about the lack of fate and effects data for the lease sale No. 53 area, combined with our overall conclusion regarding the incomplete nature of many of the environmental studies which should be included in the DEIS, lead us to make several recommendations. First, we feel that the lease sale No. 53 schedule should be modified so that data required for the production of an adequate impact statement can be fully analyzed. We suggest that a broad base group of scientists, citizens, government agency and industry personnel, such as the proposed regional technical advisory group, assist in determining when sufficient work has been completed.

We also recommend that the select committee use its influence to increase the BLM environmental studies program budget so that the studies considered essential to producing meaningful risk/cost/benefit analyses can be performed. It is our observation that the degree of citizen outcry over the proposed leasing of tracts off the central and northern California coast is a reflection of an unusually high value being placed upon aesthetic and recreational values in this region.

Similarly, the criticism of the Department of the Interior by State and local governments is also a reflection of the feelings of the citizens of this region who hold these unique marine resources in high esteem.

We urge you to carry this message to the Secretary of the Interior—that citizens, elected officials, and the scientific community are extremely concerned over the manner in which this lease sale is progressing. We feel that the process which is carefully spelled out in the OCS Lands Act and its amendments is not being adhered to, either in terms of consultation with State and local government, or relative to the conduct of environmental studies, the results of which must be included in impact statements. We urge a postponement of lease sale No. 53 until the conditions of the OCS Lands Act amendments have been met.

Finally, failing all that, in the July 1979 issue of our publication, *Oceans Magazine*, there is an article on the way in which the government of San Diego worked to get tracts deleted—see article included in insert. And they very effectively had tracts deleted once the sale had gotten down to the wire. I think your committee can be extremely helpful, if the lease sale does proceed, in helping us get some of these tracts deleted.

Thank you very much.

[The information follows:]

#### SUPPLEMENT TO THE TESTIMONY OF DR. MICHAEL J. HERZ

Reference was made throughout my testimony to the fact that although Dr. Straughan and the oil industry feel that oil has minimal effects on the marine environment, there is a large body of evidence indicating serious deleterious effects. In addition, a number of scientists have seriously questioned the quality of Dr. Straughan's work (which is so widely used by the industry to support the contention of minimal effects of oil. Dr. Hedgpeth, in his paper on the problems of environmental studies in relation to impact and management problems ("As Blind Men See the

Elephant" which No. 1 attached) has noted one category of researchers who do not even see a problem when it is in front of them. As an example of this approach he cites a recent work by Dr. Straughan on sublethal effects of natural chronic exposure to petroleum (American Petroleum Institute Publication No. 4280, 1976) in which a table without data of any sort is submitted in support of a statement that there is no correlation between biomass and organic content of the sediments. This sort of procedure is not acceptable even as a term paper and would certainly not be acceptable in any standard scientific journal in which all papers submitted are refereed.

Dr. J. H. Connell, Professor of Zoology at the University of California at Santa Barbara has also critically reviewed the methodology of some of Dr. Straughan's earlier work and found it to be deficient on a number of counts (see attached No. 2 "A Review of Straughan, D., 1979").

Reference was made earlier to the special issue of the Journal of the Fisheries Research Board of Canada (1978, vol. 35 No. ). This is one of the better sources of papers summarizing the effects of exposure to components of petroleum on the marine environment, most of them both long lasting and serious. In addition, the work of Dr. Jeannette Whipple of the National Marine Fisheries Service Laboratory in Tiburon has consistently shown serious effects of petroleum on spawning fishes and their eggs suggesting that chronic exposures to low levels of petroleum hydrocarbons will have much more serious consequences than was originally thought to be the case (see attached papers No. 3-6 by Dr. Whipple et al. on the effects of petroleum on herring, striped bass and starry flounder). If the Committee and its staff are interested, we can provide additional papers by Dr. Whipple and other indicating that exposure to very low levels of pollutant substances can produce serious persistent effects on the marine biota.

The following comments on the BLM-funded "A summary of Knowledge of the Central and Northern California Coastal Zone and Offshore Areas" by Winzler and Kelly have been assembled by Dr. Joel Hedgpeth.

Frequent reference has been made in documents and public statements by the BLM to this "Literature Survey" performed under contract to Winzler and Kelly, Inc., engineering consultants based in Eureka. Parts of this work were evidently farmed out to other people, with evidently an even shorter allotment of time to meet the deadlines (see attached correspondence No. 7). Unfortunately, the summary did not, contrary to the statement on page 25 of the Northern California OCS Environmental Studies Plan Fiscal Year 1979, "evaluate" information, and the least adequate part of the entire report concerns Bodega Head, Tomales Bay and Dillon Beach. It is disconcerting in this context to be informed in this BLM document that a "high priority" is given to this execrable performance. Student reports and a popular article by the secretary (also a free lance journalist) at Pacific Marine Station are given equal weight with refereed papers by the late R. G. Johnson. Apparently whoever compiled this section saw only one of the series of Pacific Marine Station Reports "A checklist of marine invertebrates"; but the comprehensive bibliography of published work (see No. 8 attached PMS Research Report No. 13, 1975), and many other reports of the series, are not mentioned. It is stated in reference to the statement in the popular article of 1961 about the work being done in Tomales Bay at that time that "we have not located these results in the literature." Yet on the same page they cite two papers (out of a half dozen or more) by Ralph G. Johnson which are indeed published results of the studies begun under this program.

It is discouraging to have this literature survey held up before us as an authoritative document, especially since its worst part concerns the most critical area where the greatest damage may be caused by spills or blowouts. Evidently it was not expected that this document would be used as an example of achievement by the BLM.

The Point Reyes Bird Observatory (4990 Shoreline Highway, Stinson Beach, CA) is one of the most authoritative sources of data on seabirds and mammals in the central and northern California region. The attached abstracts (No. 9) describe several projects in which this organization has been involved for the past 9 years, both of which should be of extreme interest to the BLM since they are the only source of such data. For some as yet unknown reason, the BLM Environmental Studies staff has chosen not to provide funding for the analysis of this important body of data and in light of the acknowledged need for such baseline information we would appreciate your attempting to determine why.

Finally, the attached article, "OCS Leasing Process," by Payson Stevens (No. 10) which occurred in Oceans magazine should be of interest to the Committee in terms of the manner in which lease tracts can be deleted from Lease Sale No. 53 if local

governments and citizens determine that such tracts are located in environmentally sensitive areas.

[From Oceans magazine, July 1979]

## SEA SENSE—OCS LEASING PROCESS

### SAN DIEGO CLOSES RANKS

(By PAYSON R. STEVENS)\*

Although coastal damage from oil spills is usually associated with tanker disasters, the increasing development of outer continental shelf (OCS) resources confronts the shore environment with what amounts to permanent and stationary supertankers: the offshore drilling platforms. The 1969 contamination of over 100 miles of coastline around Santa Barbara, California, from an oil drilling rig just five miles from shore illustrates that such accidents are devastating no matter what their source. However, unlike tanker movement, the construction of offshore platforms is preceded by a review process that affords local communities a measure of influence on the federal leasing of sites.

Southern California has recently gone through this process with Lease Sale (L.S.) No. 48.

In 1976, the United States Department of the Interior (DOI) opened up 217 offshore tracts between Santa Barbara and San Diego for possible bidding by the oil industry. As a result, one city became particularly active in its determined efforts to protect its coastal environment.

Concerted OCS development began with West Coast oil exploration under President Nixon's "Project Independence". Formulated in the early 1970s to counter dependence upon foreign oil supplies, the policy's purpose was to provide additional fuel for Californians, who use about ten percent of the nation's gasoline. In December of 1975, L.S. No. 35 opened up 231 tracts for exploration off the coast of Southern California. These tracts, each three square miles, were in the Santa Barbara Channel and 100 miles off the coast of San Diego in a region known as the Tanner-Cortes Banks.

San Diego was relatively unconcerned about L.S. 35 since the tracts were far from the coastline. But when L.S. No. 48 designated twenty-six tracts, six to eighteen miles from shore, people became more aroused. San Diego prides itself on being "America's Finest City." Beautiful beaches and bays bring countless tourists annually, who are drawn there by stretches of shoreline that rival the French Riviera. Because the nearshore region represents a significant economic and cultural asset for residents and tourists, San Diego could ill afford a major oil spill. And when the government figures indicated that the twenty-six tracts would only provide thirty-six hours of national consumption for oil and fifteen hours for natural gas, people began to wonder whether it would be worth the candle.

Many local and state officials felt that the Nixon and Ford Administrations had pushed the lease through without concern for regional interests. Controversies surround the sale focused on oil company bidding procedures. Some claimed that the industry benefited from low resource estimates prepared by the government agency, the United States Geological Survey (USGS). They also pointed out that oil companies frequently provide the USGS with much of the geologic data on which oil evaluations are based. Finally, the government-prepared environmental impact statement was also criticized for failing to address sufficiently the economic and social effects of oil development.

Art Letter, executive director of Concern for Offshore Oil Leasing (COOL), an anti-oil group from San Diego saw the environmental risks of L.S. No. 48 as unwarranted, especially without any coherent national energy policy. "The tracts have a low resource estimate," he commented, "and there has been a glut of Alaskan oil on the West Coast. Without any rational federal approach, it's unfair to expect any region to suffer potential severe local environmental and economic impacts. An oil spill or degraded air quality isn't worth the trade of development," he said. "The numbers don't balance."

An important political tool emerged midway in the lease sale process of L.S. 48. Up until early 1978, no legal provisions existed for local and state governments to influence OCS development. Local requests for information and participation in L.S. 35 were unsuccessful. As a result, many coastal regions started lobbying in Wash-

\*Payson R. Stevens is a biologist and science consultant. His company, Creative Consulting, provided the technical management for the CPO analysis of L.S. No. 48.

ington, circulating petitions which supported a regional role in the final tract selection.

Roger Hedgecock, a member of the San Diego County Board of Supervisors, was an active lobbyist who helped encourage other communities to oppose L.S. 48 through the League of Cities, the National Association of Counties (NACO), and the Governor's Office. Not only San Diego, but Suffolk County, Long Island, and NACO representatives testified in Washington. This East-West coalition was finally able to sponsor a coastal states resolution which amended the OCS Act to allow local participation.

"The local support created by citizens' groups like COOL, and the united efforts of various other San Diego governmental organizations gave us the muscle to go to Washington, prepare reports, hire consultants and make a case for ourselves. We knew that a strong technical base combined with a broad opposition coalition might win the deletions," Hedgecock stated. Obviously the OCS Amendments of 1978 were a critical change. Besides allowing local input on leasing decisions, they gave state OCS governors the legal right to make recommendations on DOI tract selection. These could only be overridden by a written explanation from the Secretary of the Interior. Thus, a process had evolved in which regional concerns could counterbalance federal interests.

The tracts of L.S. 48 are located in the Southern California Bight (SCB), one of the most complicated and well-studied continental terraces in the world. It spans 600 miles of coastline, from Point Conception north of Santa Barbara, to the Mexican border at San Diego. It encompasses a 21,000-square mile marine environment that includes a wide variety of ridges, basins, troughs, island shelves, and shallow banks.

Surfing, boating, skin diving, surf and sport fishing are its major recreational activities. Abalone, lobster, and kelp are all harvested from the Bight, while the principal commercial fisheries take anchovy, Pacific herring, sardine, albacore, and yellowfin tuna from its waters. The Tanner-Cortes Banks are an especially rich and unique biological habitat. The islands provide sanctuary for numerous marine sea birds and mammals, some of which are listed as endangered species, such as the brown pelican, the California least tern and the Pacific right whale. The area is also the migratory route for no less than seven whale species.

As Ken Sulzer, Deputy Executive Director of the regional governmental body, the San Diego Comprehensive Planning Organization points out, "San Diego has been evolving over the last ten years to the point where the business community realizes that a good clean environment means good business."

Public use of the Bight is supplemented by extensive military operations, submarine lanes, and naval amphibious task force bases. It is also a main shipping land, with an international port at Long Beach. Tankers carrying Alaskan crude oil as well as freighters transporting Japanese automobiles and products from the Far East navigate through the Bight.

Oil rigs and drilling operations, petroleum transfer, underwater pipelines and oil barging are the realities of OCS development. It is precisely these activities that pose questions of navigational safety, military security, marine ecosystem impact, and air quality in the southern California Bight. Added to this are questions of local, regional, state, and federal rights over development, profits, and impact costs.

Dr. Michael Mullin, professor of biological oceanography at Scripps Institution of Oceanography, views the problem from an academic perspective. "The trouble is that society is not well prepared to accumulate accurate, long-term ecological data. Most university scientists are trying to answer rather specific environmental questions. These are defined by the present state of science and not by what society needs to know five to ten years from now."

Says Mullin: "The DOI was relatively honest in what is known about the Bight and its inherent limitations in predicting effects. Yet its conclusion was to still go ahead and develop many of the tracts while forcing the burden of proof on those who are concerned about impacts. Really, it should be up to those who wish to impact the environment to prove that no serious negative effects will result."

To appraise the possible effects of OCS development, the Bureau of Land Management (BLM) organized a large multidisciplinary team to study specific aspects of Bight ecology. Science Applications, Inc. (SAI) of La Jolla was the prime contractor at \$12.4 million. According to Dr. Richard Callahan, the program manager, the four-year study was a huge one, politically pressured, and complicated by the BLM's lack of historical background for doing high-level scientific research. Obviously, problems arose. But the study demonstrated that large, diverse groups of academicians can get together and work with private industry.

Some of the problems centered around answering two basic questions: What is "normal" for a specific environment? How will it be affected by oil exploration? One



distinct problem is the existence of diverse biological environments in the Southern California Bight. The range includes coastal waters, subtidal zones, the rocky intertidal regions, sandy beaches, kelp forests, island sites, sea banks, wetlands, and bays. And there are specific areas, such as Los Angeles, Santa Barbara, San Diego, and the Tanner-Cortes Banks, which all have distinct and unique characteristics. One way the BLM tried to tackle the enormity of the task (with a three- to four-year deadline), was to look for baseline characteristics for these regions.

Baseline/benchmark studies are large-scale surveys which attempt to define major geomorphological and population features. They are often centered on a specific site and designed to gather qualitative information from well-defined areas. Unique or hazardous environments may also be described. However, this approach has inherent difficulties. Though it is possible to generally identify certain biological communities, their variability in space and time is usually significant. Natural occurrences, such as storms with intense wave action, droughts, or heavy rains all can have large disruptive effects. In order to adjust for variability, it is necessary to collect data on organisms and their physical environment for intervals longer than a mere three or four years.

With this in mind, it is not surprising that some scientists criticized the BLM approach, describing the baseline concept as unrealistic and as ultimately having a limited value for decision making.

Concerned over the direction of the research, the BLM commissioned the prestigious National Academy of Sciences (NAS) to analyze the OCS program. The result was a 109-page report, OCS Oil & Gas (NAS, 1978). It was an extensive critique, and among other suggestions recommended that long-term baseline studies be terminated.

Against this unsettling backdrop, the Pacific office of the BLM wrote the Draft Environmental Statement (DES) and published it in September of 1978 for public review. The release of the DES sparked intensive study of the document. Physical oceanographers examined and criticized the BLM oil spill model. Biological oceanographers scrutinized assumptions about Bight ecosystem dynamics and the role of hydrocarbons in the food chain. Marine geologists were skeptical of statements which minimized geologic instability and depth problems associated with drilling. The impacts of heavy metals, toxic drilling muds and turbidity effects were all examined and emphasized. Buried in the 4,000 pages were continual statements which indicated that even the BLM realized "that there were possible adverse and unknown effects from development" on phytoplankton, zooplankton, benthic organisms, and marine mammals.

Another area of controversy centered around the effects of oil discharges and spills into the marine environment. Though the effects of crude oil on marine organisms is still unclear, it is becoming increasingly evident that refined oil spills pose a long-term marine threat. A month-long symposium, held in October of 1977 on this subject, released its findings in the May 1978 issue of the *Journal of the Fisheries Research Board of Canada*. A summary statement indicated, for the regions studied that it takes upward of fifteen years for oil-fouled marine environments to return to a stable state. The entry of thousands of types of hydrocarbon molecules into marine food chains is also unknown. Concern exists over possible carcinogenic effects of some of these molecules. To date, these questions remain unanswered. It became obvious that much more research is still needed to assess oil impacts. Most importantly, the information presented a well-documented rebuttal of constant industry claims that oil poses no threats and that the environment recovers rapidly after a spill.

San Diego had the most organized regional response to the DES. Planning agencies, air quality boards, hotel owners associations, visitors and convention bureaus, and environmental groups all immersed themselves in the 4,000-page report. They dissected the document for facts and errors, shared information, and revealed faulty assumptions or conclusions.

Joan Werner, OCS policy coordinator for the San Diego County Integrated Planning Office (IPO), and a veteran of L.S. 35, described the city's twofold approach in reacting to the DES. "First, we wanted San Diego to be very strong and stand on its own, even if no one else supported us. Second, without changing our position, we wanted to cooperate as much as possible with other statewide groups."

Part of the strategy involved preparing well-documented scientific reports to provide local and national politicians with the technical leverage to argue their case. A major breakthrough occurred when San Diego pressed the BLM for subregional estimates for oil and gas. Prior to early 1977, this information had never been released, and the low resource estimates provided a valuable rallying point against the lease sale.

Another strategy focused on a conflict over federal air quality directives. The Environmental Protection Agency (EPA) decreed that cities had to clean up their air. Yet the DOI was pushing for increased drilling which would only add to deteriorating air quality. San Diego leaders were aware of Secretary of the Interior Andrus's sensitivity to these conflicts and incorporated the issue into their plan of action.

Technical reports concentrated on air quality, economic impacts, and a scientific analysis of the DES. These were contracted out to different consulting groups. The importance of solid, unbiased documentation which had credible scientists behind it was a major cornerstone of the effort. The community was also fortunate to have a report prepared by the Governor's Office of Planning and Research entitled, *Off-shore Oil and Gas Development for Southern California*. This two-volume report, released in October of 1977, offered a wealth of technical information on the possible impacts of oil development.

The climax of this intense effort was the public hearings held in late October and early November of 1978. With almost one hundred people in the audience, San Diego presented its case for two days. This was a striking contrast to Santa Barbara and Long Beach, where little opposition was voiced. The testimony was detailed and well researched. Local government agencies, the San Diego Regional Coastal Commission, California Public Research Group, Campaign for Economic Democracy, Greenpeace, the Convention and Visitors Bureau, the San Diego Hotel and Motel Association, and numerous private citizens all delivered opposition testimony.

San Diego Mayor Pete Wilson, United States Congressman Lionel Van Deerling, and United States Senator Alan Cranston appeared at the hearings and pressed for tract deletion. Though Senator Cranston did not oppose all drilling, he criticized the offshore leasing sales and said he felt the oil companies were taking advantage of the American people by not paying a high enough price to explore offshore oil. He also urged the DOI to study the cumulative effects of oil drilling.

Hervey Sweetwood, the mayor of Del Mar (a suburban coastal town), a member of the regional Coastal Commission and COOL, thought the hearings were a resounding success. "We even arranged for an informal dinner with one of the DOI panel members. In a more casual and friendly atmosphere, a small group of San Diegans and the members sat and discussed life, philosophy and oil drilling. Our purpose was to transmit to the federal government what our Southern California life style meant personally, and what the impact of oil development could mean for the region. It was a very positive experience."

For five months following the hearings, San Diego continued to press its case. COOL organized mail campaigns addressed to Secretary Andrus and national level representatives. A letter was also sent to Andrus immediately prior to tract selection which was signed by the California delegation, and asked for San Diego deletion.

All this effort paid off. On March 9, 1979, Secretary Andrus announced his decision. Sixty-nine tracts were deleted from L.S. No. 48, including all the twenty-six sites near San Diego. It was the first time in the OCS process that so many tracts were deleted for environmental reasons.

For many, the deciding factor for the deletions was the low resource estimates. But most also agree that if the region had not been outspoken in its opposition, the tracts would have been leased no matter how low the resource. Andrus had many factors to juggle: negative air quality impacts, threats to the marine environment and local economy, deepwater tracts with unproven technology, United States energy needs, and the balance of international payments. It appears, though, that an aroused public in San Diego helped tip the balance in its favor. Andrus's decision was instrumental in setting a precedent for all future frontier OCS areas. It demonstrated that a well-informed community with a documented strategy could present effective opposition to poorly planned federal directives. More importantly, it also demonstrated that the federal government was responsive to local concerns.

Even with this hopeful outcome, San Diegans are far from complacent. They are searching for alternative energy sources and have one of the first solar construction codes in the country. They also know that the BLM and oil industry are still looking at the region.

"We were disappointed by the deletion of tracts, especially the San Diego region," said Hank Wright, manager of offshore operations for the Los Angeles-based Western Oil and Gas Association. "Those areas represented the only frontier area in the sale. It's a rank wildcat region with little available information from direct drilling. Our industry expressed interest in exploring the area, especially in the light of honest domestic shortages of crude oil."

And William Grant, head of the BLM's Pacific OCS Office observed, after Andrus's decision, "If there is any future indication of a greater resource in the San Diego region, then the tract selection process will have to be reevaluated. Even low resource areas will be considered if the crude oil problem continues."

Over thirty new OCS sale areas will be opening up during the next five years. It is obvious that America cannot continue its addiction to nonrenewable energy. Our cheap sources are ending, some predict within twenty-five years for American oil at the current consumption rate. We are in a postindustrial transition which will require creative solutions, energy restraints, and a global perspective. Local communities have to be aware of the trade-offs. More significantly, we must always be conscious of the delicate relationships which exist in the ocean, and diligent in protecting this vital resource.

What was unique about L.S. No. 48 was the united community voice which spoke out against oil development. The model presented here may not work everywhere. But it does show that people can stand together, present their case, and even win! And what they gained was the sky, the air, and the sea.

Effects of Inherent Parental Factors,  
Including Pollutant Uptake,  
on Gamete Condition and Viability in Striped Bass  
(Morone Saxatilis)

by

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Summary of a Paper Presented  
at the Symposium on The Early Life History of Fish

Woods Hole, Massachusetts

April 1979

In the spring of 1978, samples of adult striped bass were collected off Antioch, California on the San Joaquin River during their upstream spawning migration and after they passed through the heavily industrialized Carquinez Straits area. Post-spawning adults were collected in San Francisco Bay near the Tiburon Laboratory.

A total of 73 migrating, pre-spawning striped bass and 100 post-spawning fish were collected and 165 parameters measured for each fish. Complete autopsies were performed and subsamples taken for various measurements. The purpose of this sampling was: 1) to determine the condition of parental fish just prior to spawning and to ascertain whether certain measures of parental condition correlated with measures of gametic viability, and 2) to identify factors which might relate to the annual "fish kill" of adult striped bass in the Carquinez Straits during the summer.

The complete version of this paper presents research results which indicate that pre-spawning fish, their gonads and gametes, and post-spawning fish are being deleteriously affected during their migration through the San Francisco Bay-Delta estuary, and that the degree of this effect is determined by interaction of the parental genotype with environmental stress factors, including pollutants. Factor analysis of 165 variables (22 data sets - Table 1) and covariance analyses of factors were performed.

In brief summary, the results show there is genotypic variability in the serum proteins albumin and transferrin, the egg pigments (varying shades of green to yellow), melanistic color patterns and certain meristic characters. The variability in some of these characteristics correlates with different physiological types, varying in their resistance to environmental exigencies and parasitism.

One hundred years ago (1879), 332 juvenile striped bass from the Navesink River on the east coast of the United States were released into the San Francisco Bay-Delta estuary of California.

Over the intervening years, sport and commercial catch records have indicated considerable fluctuations in the Pacific striped bass population (Smith and Kato, in press). To determine the causal mechanisms controlling these fluctuations, California Department of Fish and Game (CDF&G) has conducted extensive studies since 1958 on the California striped bass and their habitat.

CDF&G field data indicate that mortality during the first 60 days after hatching determines the size of the adult population. Abundance of young-of-the-year juveniles is related to river outflows and diversion volumes in the Sacramento-San Joaquin River Delta (Chadwick, et al., 1977).

However, aside from direct export of eggs and larvae out of the estuary via water diversions, the primary causes of mortality remain undetermined. There is no clear understanding of the primary mortality factors determining survival of striped bass during the first two months of life. Because of this, NMFS Tiburon Laboratory began intensive laboratory studies on mortality factors affecting egg and larval stages of striped bass (Eldridge, et al., 1977; Eldridge, et al., 1978).

In 1978, we also initiated studies on the effects of selected inherent factors such as the condition of spawning adults and their genotypes on gametic viability of eggs. Our previous research on effects of aromatic petroleum hydrocarbons showed that fish during spawning condition were extremely sensitive to short, low-level exposures (Struhsaker, 1977; Whipple, et al., 1978). There were also subsequent deleterious effects on survival and growth of eggs and larvae from exposed females.

Table 1. Striped Bass field samples (1978 and 1979): Data Sets collected. (Total of 165 variables measured on each fish)

1. Field Sampling - Environmental and Capture Data
2. Meristics; Length, Width, Age, etc.
3. Color Pattern
4. Gonads; Length, Width, Weight, Fecundity
5. Liver, Gall Bladder, Stomach
6. Parasites and Disease
7. Histology - Gonads
8. Histology - Other - Liver, Spleen, Kidney, etc.
9. Chemistry - Lipids, Carbohydrates, Proteins, Calorimetry
10. Chemistry - Iron and Heavy Metals
11. Chemistry - Pigments
12. Pollutants - Petroleum Aromatic Hydrocarbons, Aryl cyclohexanes
13. Pollutants - Pesticides - Chlorinated Hydrocarbons, PCB's
14. Pollutants - Other Pollutants
15. Electrophoresis - Total Protein, TFN, Albumin, LDH
16. Blood - Hemoglobin, Hematocrit, Erythrocyte Fragility
17. Blood Cells - Red Blood Cells
- 18-
21. Blood Cells - White Blood Cells; Thrombocytes, Lymphocytes, Monocytes,  
Macrophages, Granulocytes, Neutrophils,  
Eosinophils, Basophils
22. Egg Diameters

A high percentage of the parental fish were in poor condition, as indicated by body condition factors (low), macroscopic observations during autopsy, body lesions (approx. 35%), level of parasitism (approx. 50% showing parasitic damage to organs), and the blood cells (low numbers of lymphocytes, high numbers of granulocytes), among other parameters. Liver and ovary tissues sampled were found to contain high levels of zinc (up to 90 ppm; wet weight) and aromatic and aryl cyclohexane petroleum hydrocarbons (up to 2 ppm; wet weight). There was a correlation between the poor condition of the parental fish and the ability to reproduce (12% of adult females did not ripen, 20% of those ripening had damaged ovaries (parasitism) or dead eggs in ovaries) and fecundity and viability of eggs was reduced in the adults in poorer condition and/or with high pollutant content.

Preliminary data from sampling in the 1979 spawning season show similar results.

The overall decline in the striped bass population may be partially attributable to decreased reproduction and fecundity due to increasing effects of pollution, interacting with diversion and the low outflow years to increase mortality of eggs and larvae. Some mortality in the adult population also occurs, possibly because the adults are highly stressed from the interaction of pollutant and parasitic stress with spawning stress. The adults experience further stress as they migrate downstream through Carquinez Straits after spawning, encountering salinity and pollution stresses in the null zone, and a proportion of "weaker" fish die. The interaction of these factors may explain the annual "fish kills" in early summer (Kohlhorst, 1973). Studies of this problem are continuing at the NMFS Tiburon Laboratory.



## LITERATURE CITED

- Chadwick, H. K., D. E. Stevens and L. W. Miller, 1977. Some factors regulating the striped bass population in the Sacramento-San Joaquin Estuary, California. In Proc. of the Conference on Assessing the Effects of Power-Plant-Induced Mortality in Fish Populations (W. Van Winkle, ed.). Pergamon Press, pp. 18-35.
- Eldridge, M. B., D. King, D. Eng and M. Bowers, 1977. Role of the oil globule in survival and growth of striped bass (Morone saxatilis) larvae. Procs. 57th Ann. Conf., West. Assoc. of State Game and Fish Comm., pp. 303-313.
- Eldridge, M. B., J. A. Whipple, D. Eng and M. Bowers, 1978. Laboratory studies on factors affecting mortality in California striped bass (Morone saxatilis) eggs and larvae. Procs. 108th Ann. Meet., Amer. Fish. Soc., U. of Rhode Island. In Press.
- Kohlhorst, David, 1973. An analysis of the annual striped bass die-off in the Sacramento-San Joaquin estuary, 1971-72. State of Calif., Resources Agency, Dept. Fish & Game, Anadromous Fish. Branch Admin. Rpt. No. 73-7.
- Smith S. E. and S. Kato. In Press. The fisheries of San Francisco Bay: past, present and future. In San Francisco Bay: The Urbanized Estuary. (T. J. Conomos, ed.). American Assoc. Adv. Sci., Pacific Division.
- Struhsaker, J. Whipple, 1977. Effects of benzene (a toxic component of crude oil) on spawning Pacific herring (Clupea pallasii). Fish. Bull. 75:43-49.
- Whipple, J. A., T. Yocom, D. R. Smart and M. Cohen, 1978. Effects of chronic concentrations of petroleum hydrocarbons on gonadal maturation in starry flounder (Platichthys stellatus (Pallas) ). Procs. of Conference on Assessment of Ecological Impacts of Oil Spills, June 14-17, 1978, Keystone, Colo. A.I.B.S. pp. 756-806.

## AS BLIND MEN SEE THE ELEPHANT: THE DILEMMA OF MARINE ECOSYSTEM RESEARCH

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*Abstract:* We are beset in these days of impact assessments, environmental monitoring and all, with the problem of studying a complex system in some way that will convince us we know what is going on and that we can predict the effect of our actions on this system. Meetings on this subject tend to fragment into lobbyists for the various approaches. The Baconian ideal of compiling all knowledge and consigning it to the computer to tell us what to think about it all is the ultimate extreme on one side, and the notion that one (or perhaps two) numbers from a dying mussel may be all we need is the other extreme of the ancient problem of deducing the state of affairs from diverse concepts based on limited vision or perhaps no vision at all, but a disconnected set of tactile impressions of the elephant. Or, to put it another way, how we can be certain we are not still prisoners in Plato's cave?

During the 1976 International Marine Biology Symposium at Helgoland, I was asked to organize, or at least convene, a discussion of the needs of marine ecosystem research. It turned out to be a frustrating experience for a number of reasons, and the discussion was not only inconclusive but also brought to mind the old story about the blind men trying to visualize an elephant from a disconnected set of tactile impressions (Hedgpeth, 1977d). Yet the need to develop research approaches that can provide us with predictive information and support conclusions on which to base management decisions in our pollution-ridden world are very much with us. In spite of the considerable body of knowledge that has been built up about the North Sea, for example, we still do not have the right information on which to base predictions for management. Here is a body of water lying between the highly industrialized and heavily populated continent of Europe and Great Britain, which has been treated ever since modern civilization developed as a waste disposal sink, yet does not seem to be dangerously polluted (Goldberg, 1973). After a century of research, we cannot manage this region as a natural interaction of biological and physical factors, and indeed the question was raised, appropriately, by a gentleman from Vienna: are ecosystems real enti-

ties, or concepts associated with the ordering nature of our mind?

Of course, all our concepts of nature are simplifications or abstractions and are "to some extent therefore a fairy tale," as the meteorologist Sir Napier Shaw said. This quotation, which introduces the chapter on the concepts of marine ecology that I wrote twenty years ago (and now is somewhat out of date), is the most important, and evidently least read, part of that attempt to summarize matters (Hedgpeth, 1957). The latest word for this process of simplification appears to be paradigm, which the dictionary tells me means "example, model or pattern," but which in some recent usage seems to mean something else, an exemplary abstraction arrived at by a process of "capsulization," which sounds like some idealization of abstract values and virtues. Perhaps some of the people who use this word these days have never looked it up in the dictionary and have it confused with paladin. In any event, according to the document, "An ecosystem paradigm for ecology" (P. L. Johnson *et al.*, 1977), the ecological paradigm is comprised of "statements and discussion." They do conclude, which is more to the point of this discussion, that "ecologically controlling variables are only partially within man's grasp." But do we need to "grasp variables"? An unfortunate word in this context, since it brings to mind grasping at straws. I am also afraid that this capsulogenous proclivity will not encourage those who have been exposed to an undergraduate course in ecology, and have since become bureaucrats and/or administrators (the terms are not necessarily synonymous), to keep up with the subject.

Whatever the ecosystem may be, or how complicated, or whether it is simply another word for the natural world we are part of, there are obviously too many things going on to study all of them or gather data on everything at once and ask the computer to tell us what it all means. Our concern is to understand the environment well enough to make predictions and hope to manage it, or at least control ourselves and our actions so that we will not find ourselves living on a vast dung heap beside a vaster cesspool. Such understanding and ultimate management is incompatible with political exigencies, the need for the quick fix. Things must be done, or at least appear to be done, between elections or budgets, to justify renewed incumbencies or refunded budgets. Most scientists refuse to consider this illogical approach to environmental management significant or even worth mentioning at all. Yet this sudden death urgency governs much of the demand for convincing data to support decisions, preferably by yesterday. And, of course, the sensible advice that if you do not know what the effect of an action or of a possible pollutant is going to be, you should not do it or use it, is unacceptable in our economic or political structure. We have to keep our hubristic, anthropocentric system going: "When it becomes a choice between ecology and people, people must go." A recent circular, soliciting subscriptions for a new magazine about the ocean, put this very clearly: "Our aim is to contribute to a wider public understanding of the oceans and to a greater appreciation of how they can serve us, today and in the future." Whoever wrote this bit of advertising copy has forgotten that even King Canute was unable to order the ocean to do

his bidding. Nevertheless, it is a growing concern that if ecology goes, so will people, and hence our need for understanding the consequences of our acts and activities.

When we ask what part of nature our actions affect, without really understanding the entire ecosystem, we find ourselves among those blind men who touched various parts of the elephant without comprehending the nature of the whole animal. The inconclusive result of the discussion at Helgoland was inevitable because of the effort to represent various viewpoints, especially after the reservations expressed about the utility of complicated, all-encompassing models, both by myself (Hedgpeth, 1977b) and members of the panel discussion of the question "Can we manage the North Sea?" Models may be here to stay, but they should not be articles of faith. Modelers ought to get together and strive for a unified theory of modeling (Conway, 1977), and there should be more awareness of the difficulties involved: "It should be understood that modeling is an art for extremely qualified experts and that sophisticated numerical models are not a necessary part of every water quality plan. Models should be used only where they are really needed, and then only by persons with extensive familiarity with the model and its limitations" (Fischer, 1977).

This quotation refers to physical or hydrographic models rather than to those of natural systems, where the inferences and often the data are more subjective or involve increments of time and dimension not amenable to the requirements of the engineer. Some of these difficulties in modeling natural systems have been pointed out with special reference to managers and politicians: "Ecologists might best contribute to resource management by stressing the ambiguities in our knowledge about natural communities, and induce managers and politicians to make decisions that openly acknowledge that they are sometimes based on tentative information" (Hedgpeth and Obrebski, 1976). The same advice has been suggested for lawyers who should realize that "passing laws, adopting regulations, and even winning court cases do not necessarily resolve all the problems that may arise in understanding and coping with the consequences of action that may affect the natural environment" (Heikoff, 1977: p. 280). Lawyers should also be advised that models may be hypothetical or illustrated by trial runs of possible or even impossible conditions that cannot be used as factual evidence.

It is natural that each of us should consider our own limited approach to ecosystem research the best one, or at least the approach most useful in understanding the whole, because we are most familiar with it. This can produce a somewhat parochial approach to matters, like our east coast *Spartina* syndrome. This notion, actually a sort of model carried to its ultimate emphasis, is that the salt marshes are the key to productivity of the estuarine system because of the contribution of their detritus, and it follows that the best thing to do for an estuary system is to promote the growth of *Spartina*. In some California estuaries, however, the marsh is often separated from the deeper waters of the bay by extensive mud flats which are a significant component of the productivity and organic cycles in the estuary (Nichols, 1977). Similar conditions prevail in the

European Waddensee, where "detritus imported from salt marshes . . . is relatively unimportant and the secondary productivity from the tidal flats is more significant" (Wolff, 1977). Thus, recommendations that California estuaries need more *Spartina* marshes may actually result in interference with a natural system by accelerating sedimentation and accretion and consequent reduction of the mud flats.

Another danger is already apparent. In Oregon, where there is no native estuarine species of *Spartina* (there is a species associated with alkaline lakes), *Spartina patens* has become established in one locality, and appears to be rapidly crowding out the native high salt marsh vegetation. Spread of this plant into other coastal marshlands of the Pacific Coast may bring about drastic and unfortunate changes in the ecosystem.

Almost as dangerous as misplaced emphasis on individual species is misplaced faith in some magic number or symbol. Back in the innocent days of ecology, it was pH. There is the possibly apocryphal story of the professor on the dock at Woods Hole advising the field party embarking for a day of data gathering to leave all their gear behind except the pH kit. In our day, the magic number has been the diversity index. From the various ideas about the association of diversity with stability or "age" which have not withstood the judgment of time (Goodman, 1975), some sanitary engineers concluded, with innocent subjectivity, that diversity was an indication of "health": "In the field of ecology, it is generally accepted that an adverse environment will result in a decrease of the number of species, although the total number of organisms of a given species may increase because of reduced competition. Thus, an examination of the diversity of organisms may provide a measure as to the general health of the environment. In order to avoid subjective appraisals or measures, it is preferred to have a quantitative, mathematically defined concept of diversity" (Pearson *et al.*, 1967). Unfortunately, there was inadequate attention to the systematics of the organisms, and the totals of species identified varied from year to year because of varying standards of identification and identifiers, so that indexes developed according to this concept could not be compared. The diversity index approach is useful in determining the internal consistency of a sampling program, but objective application of diversity indexes for any purpose requires rigorous taxonomics and sampling control, as exemplified in such studies as those carried out in Tomales Bay by R. G. Johnson (1970; 1971). It is misleading when compiled from inadequately treated material and may be as uninformative as a series of random numbers, yet such diversity indices are acceptable and sometimes required in many pollution studies.

In Helgoland, we did try to discuss the essential needs for research in the marine ecosystem, but we were derailed for some time by a discussion of the utility of *Mytilus edulis* as an index organism by an indomitable person from Poland, a subject already considered at some length in a large book (Bayne, 1976). One species alone cannot tell us much about the ecosystem as such; when the canary dies in the mine, we know we should get out, but not necessarily why

there is no air. *Mytilus edulis* is nevertheless a more or less accepted index species for certain substances, and such a popular species for pollution monitoring (Goldberg, 1976) that we now have a world-wide "mussel watch" program.

The other extreme is that we need to know, and to assemble as much data as possible from all available sources, about as many species as possible, and the best way to do this is to consign it all to a computer. A plan for some sort of master index of all species, all variables, all knowledge, is proposed by the EPA (for an applied example of the data bank approach, see Henderson *et al.*, 1976) as a sort of modern day fulfillment of Francis Bacon's ideal of assembling all knowledge and then attempting to understand the nature of the world from it. Bacon would have done well in this age of computers, but Aristotle would have learned more. It is useful to have all this information and to be able to arrange it in all possible sorts of ways, but we must not let it become an end in itself nor trust what the computer says, because the questions it answers are those we have asked of it. (Or one may not have to ask any questions at all: one supplier of black boxes that sense all variables claims that his "data logger . . . puts the entire environment within the reach of the computer." The ultimate result of this could be herds of black boxes wired to computers perpetually pouring out numbers.) And, whatever the question, the nature and reliability of the data are as critical as their quantity.

Then there is the approach that field studies or *in situ* observations will be the answer, and that in any event we need base line studies (which are of course field studies) to tell us what to expect of an ecosystem under stress. This approach, which involves asking questions before we know which ones to ask, can easily degenerate into the tedium of monitoring, i.e., repeated recording of the same information which may or may not be significant. Detailed monitoring, especially the identifying, counting, and measuring of innumerable species can be more time-consuming and expensive than the results justify, and is not very inspiring intellectually. One of the active practitioners of this type of before-the-event modeling recommends — in view of the limitations of base line studies because of our lack of knowledge of factors that govern recruitment, success, and mortality of littoral species in particular — that we use semi-quantitative methods and spend as little time as possible on such studies (Crapp, 1971). The shortcomings of sampling the bottom of the sea, especially in the days before diving spheres and frogmen, were fully realized by the founding father of quantitative sampling, C. G. J. Petersen, who not only reproduced the amusing drawing by Edward Forbes of the shortcomings of the dredge, but also made famous that comparison by his colleague, H. G. Jungersen: "A dredging ship may be compared with an air-ship towing a dredge over Copenhagen, catching a policeman in one street and a perambulator in another; and from these it draws conclusions as to the whole population of the town" (Petersen, 1914: p. 21).

Some paleoecologists have no qualms about the incomplete nature of their data. It has been suggested that a few dead shells may be better than the complexity of a living system: "Indeed, the assemblages of dead invertebrates appear

to be more useful for environmental interpretations than the actual living assemblages, even when available" (Warne *et al.*, 1976). The inference from this would seem to be that we can take our sample, let all the soft stuff die, and then make deductions about the state of the community in the present as well as the past. This suggests that we might infer what killed the elephant from a handful (or perhaps bucketful) of metatarsals and phalanges. "This idea can certainly not be applied to the metastasizing field of environmental impact ecology," although it would, of course, "save us a lot of grubby sampling of worms and other creepy crawlies" (Hedgpeth, 1977b). The idea belongs in the same category as treating the fossil record as a sort of experimental diary of perturbations (Rosenzweig, 1977), which Mark and Flessa (1977) criticize from the viewpoint of the fossil record as "a risky undertaking."

Although concerned with the problems of studying freshwater ecosystems, the critical discussion by Hellowell (1977) is a more than adequate antidote for the reductionist approaches suggested by paleoecologists, modellers, and seekers of the mystic and magic number. This paper should be consulted by all of us concerned with ecosystem research:

The ecosystem may conveniently be regarded as being built up from a series of sub-sets comprising individuals, species, bio-coenoses, populations and communities, with each component contributing its properties to determine the character of the larger sets [Figure 1]. Surveillance may be undertaken at all organizational and trophic levels within an ecosystem, from the individual to communities, and each will contribute towards our understanding of the structure and function of the system. For example, the identities of species present can provide considerable information if their autecology and synecology are known. The proposition that many environmental insights would be derivable from consideration of a species list if tolerances, preferences and relationships of species were better known is attractive and has led to the concept of "indicator" species. Criticism of this concept has probably arisen from disappointment with the, as yet unrealized, premature aspirations of its proponents. In reality, few species are understood well enough to permit their use as ecological "litmus-paper" and the complexities of biological systems probably preclude such a simple approach. However, there appears to be no reason why, ultimately, all species should not be indicators, given sufficient knowledge of their ecology.

The individual as a unit, ignoring its identity, seems to be one of the least useful components for consideration, although it possesses physiological attributes which might be of interest. Groups of individuals, whether mixed or single species populations, are more useful and can effectively be used to detect spatial or temporal change. An interesting example of the use of populations without detailed identification is the use of algal cell counts or chlorophyll determinations to estimate algal biomass and hence potable water quality.

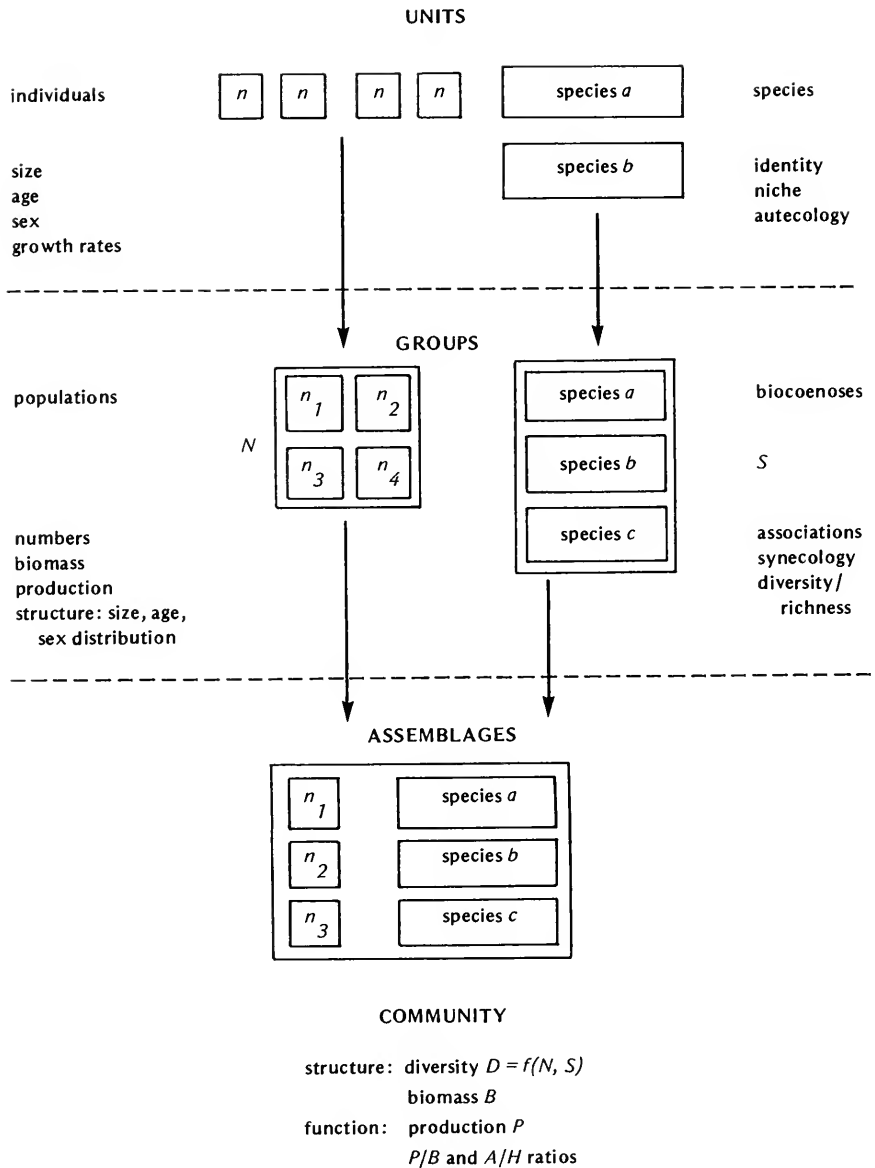


Figure 1. A conceptual framework of community organization and the structural or functional measures appropriate to each level (Hellawell, 1977).



Biocoenoses or groups of species occurring together are qualitative attributes of ecosystems which are probably more informative than indicator species, especially when the normal biocoenosis-habitat relationship is known. Assemblages of populations and biocoenoses form communities and provide quantitative measures of biocoenotic attributes. Studies at the community level ought to include all populations of organisms present within the area of the habitat but, in general usage, consideration is often restricted to particular taxonomic groups since resources or expertise are rarely sufficient to tackle the whole community (Hellawell, 1977: pp. 34-36).

This citation of a freshwater example is not intended to imply that little of value was said at Helgoland. On the contrary: the theme of the symposium was ecosystem research and there were many valuable contributions to this general problem, beginning with the opening papers of the proceedings (published as Volume 30 of *Helgoländer wissenschaftliche Meeresuntersuchungen*, in 735 pages!), notably those by Fishelson (1977) on stability and instability of marine ecosystems and by Oviatt *et al.* (1977) on studies of experimental marine ecosystems. A significant contribution to the modelling problem is Gary's (1977) paper on stability of benthic ecosystems, concerning once again the moot problem of succession in marine communities. The concept of neighborhood stability seems more realistic than that of global stability or succession-climax, but would require models "an order of magnitude more complex."

The Helgoland meeting was immediately followed by the 11th European Symposium on Marine Biology at Galway; the published proceedings of this symposium, *Biology of Benthic Organisms* (Pergamon, 1977) occupy 630 pages, and there are many contributions of direct significance to our problem. Earlier in this same year another symposium volume, *Ecology of Marine Benthos* (University of South Carolina Press, 1977) was published, although the conference at which the papers were presented was held in May of 1975. This volume, of 465 pages, has an index which may explain in part the delay in publication. It will take some time to assimilate and synthesize these three massive contributions which, if nothing else, testify to the extent of interest and research in problems all directly related to the analysis of marine ecosystems.

Some investigators, even though not blind, can walk right by an elephant and not see it at all and consequently may not even believe in its existence. For them, there is no question and no problem. It is possible to conclude like some blithe spirit that the absence of data means there is nothing to correlate, or that such data as there may be indicate no effect of A on B. Some data of this kind may sound imposing and authoritative, based on ten man-days of study which may mean that a group of twenty students spent half a day gathering the data. Whatever the nature of the information, it is certainly turning away from our troublesome elephant to conclude that a table showing nothing can be used to substantiate a claim that "no correlation" is discernible (Figure 2).

There were no correlations between the major species groups (Vermes, Crustacea, Echinodermata, Mollusca) in terms of biomass and total organics, silt, and water depth (Table 22). All species groups were found in sediments with high and low total organic content. This was in contrast to suggestions elsewhere that Crustacea are the most sensitive group to petroleum.

TABLE 22.

Relationship Between Biomass of Major Phyla and Total Hydrocarbons, Sediments (in terms of silt) and Depth

Phyla	Total Organics*	Silt	Depth
Vermes	-	-	-
Crustacea	-	-	-
Echinodermata	-	-	-
Mollusca	-	-	-

\*As determined by carbon tetrachloride analysis and infra-red analysis.

Figure 2. Q. E. D.: Where there are no data, there are no correlations (Straughan, 1976).

Nature is admittedly too complex for most of us, and some of us think we can do better in assessing potential effects of some environmental variables and pollutant substances by laboratory tests, especially on a suite of standardized test animals. There has been some confusion about exactly what is determined by testing tolerances with a small menagerie of almost invulnerable animals adapted to laboratory conditions and, in any event, not found in the sea. This use of standardized test animals has not been completely understood by the critics or, perhaps, adequately explained by the principal advocate of the method, as indicated by the running comments and discussions between European investigators and the chief keeper of "Tarzwell's Zoo" at a symposium on oil pollution (Hepple, 1971).

Of course, much of our knowledge about the reactions of organisms to various environmental variables has been derived from the standard procedures of physiology. Usually these involve testing a single factor while keeping the other environmental variables constant, and often it has been found that tolerances in nature may be different from those in the laboratory, primarily because of the interaction of several variables. It is not possible, for example, to discuss

the effects of temperature in marine animals without also considering at least salinity and oxygen, as demonstrated by Kinne's masterful review of the subject (Kinne, 1970). Various ways of considering and representing combined effects are discussed by Alderdice (1972). Obviously, this type of treatment requires access to a computer, and interpretation of the curious graphs produced suggests again the need for that most subtle and indispensable of computers, the old-fashioned naturalist.

With some animals, especially perhaps well-known bivalves, it is possible to test field conditions in experimental apparatus (Bayne *et al.*, 1977). Insofar as polluted water is concerned, environmental or field conditions may be simulated in medium-sized experimental tanks and the potential effect of polluted water may be determined, although the exact effect of a particular component of the pollution may not be clearly identified (McIntyre, 1977). Here again, however, an essential aspect of nature has to be passed over lightly, i.e., the natural spacing and interactions of the organisms extracted from their environment and placed in the experimental containers. Even under experimental conditions in the environment, the results are sometimes difficult to interpret or may appear to lead us in the wrong direction (Arntz, 1977; Dayton, 1973).

The lesson of the blind man and the elephant is that the whole is greater than its parts and that a complex, most improbable animal like the elephant cannot be visualized as a summary of its parts. Perhaps the analogy is unfair; even with 20-20 vision, one cannot see all of the animal, especially what is going on inside. In this respect, our dilemma is that of the prisoners in the cave who can see only the shadows on the wall projected from the real world outside. But we, like Aristotle, cannot live with Plato's limitation, and we at least can look out of the cave and attempt to perceive the whole. "We have better means of information, however, concerning the things that perish, that is to say, plants and animals, because we live among them . . . . Let us now endeavor to describe the causes of all these things, particular as well as common; and, according to the principles laid down, we will begin with first things first (Aristotle, *Parts of Animals*, I.v.)."

## Epilogue

Of course I did not think of quoting Aristotle at the necessarily brief presentation of some of these ideas in that honeymoon resort in the Poconos, but I did warn the audience that any resemblance between what I said and what I would write would be to some extent a coincidence.

It is difficult not to be somewhat negative when discussing the need to know everything in order to manage the environment in which we live (even or especially, to our own benefit), and when asked how would I go about the necessary studies if I were God, I could not resist the retort that I was being given six days for the job. When one looks at some of our fellow creatures, especially the elephant, one does wonder whether God (or Nature) is always practical. In any event I do not have a direct, personal line of communication with Higher Authority on these matters, and the best I could recommend was that we do as much as

possible as often as possible within our means and limitations. We should develop a simplified regime of measuring and sampling that would permit us to span at least a significant period of time with respect to the natural systems involved. This, of course, means that we must have more than six days, and it is we who must give ourselves that time. We hope for information that will enable us to make reasonably intelligent guesses about how to manage and protect our brief tenure on "this dark terrestrial ball." At best we will always have to accept uncertainty and inadequacy in both knowledge and environmental management, and to rely on subjective judgment, which in this context we prefer to think of as the experience and wisdom of the "old fashioned naturalist." The problem is cogently put in a retort to one of the innumerable critics whose remarks rise to the surface in the appendix to the draft of an environmental impact report: "The day that we have a 'thorough understanding of the population and community dynamics of . . . plankton . . . nekton and benthos,' as the reviewer suggests, is the day that all the speculations associated with environmental impact assessment will cease, and all marine ecologists can retire."

Retire from preparing impact assessments, indeed, but not from contemplation of the living world, preferably near some sunlit, shallow lagoon where they can see the bottom through the clear water and observe what is going on.

## References

1. Alderdice, D. F. 1972. Response of marine poikilotherms to environmental factors acting in concert, pp. 1659-1722. *In* Otto Kinne (ed.), *Factor Combinations in Marine Ecology*, 1(3).
2. Arntz, W. E. 1977. Results and problems of an "unsuccessful" benthos cage predation experiment, pp. 31-44. *In* B. F. Keegan, P. O. Ceidigh and P. J. S. Boaden (eds.), *Biology of Benthic Organisms*. 11th European Symposium on Marine Biology. Pergamon Press.
3. Bayne, L. (ed.) 1976. *Marine Mussels, their Ecology and Physiology*. Cambridge University Press, 506 pp.
4. Bayne, B. L., J. Widdows and R. I. E. Newell. 1977. Physiological measurements on estuarine bivalve molluscs in the field, pp. 57-68. *In* B. F. Keegan, P. O. Ceidigh and P. J. S. Boaden (eds.), *Biology of Benthic Organisms*, 11th European Symposium on Marine Biology. Pergamon Press.
5. Connell, J. H. 1974. Field experiments in marine ecology, pp. 21-54. *In* R. N. Mariscal (ed.), *Experimental Marine Biology*. Academic Press.
6. Conway, G. R. 1977. Mathematical models in applied ecology. *Nature* 269: 291-297.
7. Crapp, G. B. 1971. Monitoring the rocky shore, pp. 102-113. *In* E. B. Cowell (ed.), *The Ecological Effects of Oil Pollution on Littoral Communities*. Institute of Petroleum, London.
8. Dayton, P. K. 1972. Toward an understanding of community resilience and the potential effects of enrichments to the benthos at McMurdo Sound, Antarctica, pp. 81-96. *In* B. Parker (ed. and inadvertent publisher), *Proceedings of the Colloquium on Conservation Problems in Antarctica*.
9. \_\_\_\_\_. 1973. Two cases of resource partitioning in an intertidal community. Making the right prediction for the wrong reasons. *Amer. Nat.* 107 (957):662-670.

10. Fischer, H. B. 1977. The effect of estuarine circulation on pollution dispersal, pp. 477-485. *In* Estuarine Pollution Control and Assessment. Proceedings of a conference, Vol. 2. Environmental Protection Agency, Washington, D.C.
11. Fishelson, L. 1977. Stability and instability of marine ecosystems, illustrated by examples from the Red Sea. *Helgolander wiss. Meeresunters.* 30:18-29.
12. Goldberg, E. D. (ed.) 1973. North Sea Science. NATO North Sea Science Conference, Aviemore, Scotland, 15-20 November 1971. MIT Press, Cambridge, Mass. 500 pp.
13. Goldberg, E. D. 1976. Strategies for marine pollution monitoring. John Wiley & Sons, New York.
14. Goodman, D. 1975. The theory of diversity-stability relationships in ecology. *Quar. Rev. Biol.* 50:237-266.
15. Gray, J. S. 1977. The stability of benthic ecosystems. *Helgolander wiss. Meeresunters.* 30:427-444.
16. Hedgpeth, J. W. 1957. Concepts of Marine Ecology, pp. 29-52. *In* Treatise on Marine Ecology and Paleocology, Memoir 67, Geol. Soc. America, Vol. 1.
17. \_\_\_\_\_. 1973. The impact of impact studies. *Helgolander wiss. Meeresunters.* 24:436-445.
18. \_\_\_\_\_. 1977a. Seven ways to obliteration: factors of estuarine degradation, pp. 723-737. *In* Estuarine Pollution Control and Assessment. Proceedings of a conference, Vol. 2. Environmental Protection Agency, Washington, D. C.
19. \_\_\_\_\_. 1977b. Review: Structure and classification of paleocommunities. *Paleobiology* 3(1):110-114.
20. \_\_\_\_\_. 1977c. Models and muddles. Some philosophical observations. *Helgolander wiss. Meeresunters.* 30:92-104.
21. \_\_\_\_\_. 1977d. Comments on an attempted discussion about the needs for marine ecosystem research. *Idem*, pp. 705-706.
22. Hedgpeth, J. W., and S. Obrebski. 1976. Ecosystem models and resource management. *Bulletin The Coastal Society* 1(2):5-10.
23. Heikoff, J. 1977. Coastal Resources Management. Ann Arbor Scientific Publications.
24. Hellawell, J. M. 1977. Change in natural and managed ecosystems; detection, measurement and assessment. *Proc. Roy. Soc. London (B)*, 197:31-57.
25. Henderson, R. S., S. V. Smith and E. C. Evans III. 1976. Flow-through microcosms for simulation of marine ecosystems: development and inter-comparison of open coast and bay facilities. U.S. Navy Undersea Center, San Diego. Report no. TP 519, 80 pp.
26. Hepple, P. (ed.) 1971. Water Pollution by Oil. The Institute of Petroleum, London (Elsevier, Amsterdam). 393 pp.
27. Holme, N. A., and A. D. McIntire (eds.). 1971. Methods for the Study of Marine Benthos. IBP Handbook No. 16. Blackwell Scientific Publications, Oxford & Edinburgh: 334 pp.
28. Johnson, P. L. (ed.) 1977. An ecosystem paradigm for ecology. Oak Ridge Associated Universities, 20 pp., April 1977.
29. Johnson, R. G. 1970. Variations in diversity within benthic marine communities. *Amer. Nat.* 104(937):285-300.
30. \_\_\_\_\_. 1971. Animal-sediment relations in shallow water benthic communities. *Marine Geol.* 11:93-104.

31. Kinne, O. 1970. Chapter 3. Temperature, 3.3, Animals, 3.31, Invertebrates. *In* Marine Ecology, 1(1):407-514.
32. McIntyre, A. D. 1977. Effects of pollution on inshore benthos, pp. 301-318. *In* B. C. Coull (ed.), Ecology of Marine Benthos. University of South Carolina Press.
33. Mark, G. A., and K. W. Flessa. 1977. The fossil record is not an experimental diary. *Paleobiology* 3(3):324.
34. Nichols, F. H. 1977. Infaunal biomass and production on a mudflat, San Francisco Bay, California, pp. 339-357. *In* B. C. Coull (ed.), Ecology of Marine Benthos. University of South Carolina Press.
35. Oviatt, C. A., K. T. Perez, and S. W. Nixon. 1977. Multivariate analysis of experimental marine ecosystems. *Helgolander wiss. Meeresunters.* 30:30-46.
36. Pearson, E. A., P. N. Storrs, and R. E. Selleck. 1967. Some physical parameters and their significance in marine waste disposal, pp. 297-315. *In* T. A. Olson and F. J. Burgess (eds.), Pollution and Marine Ecology. Wiley, Interscience, New York.
37. Petersen, C. G. J. 1914. Valuation of the Sea II. The animal communities of the sea-bottom and their importance for marine zoogeography. Report Danish Biological Station, 21, 1913, 44 pp.
38. Rosenzweig, M. L. 1977. Does the fossil record provide for natural experiments? On interpreting the results of perturbation experiments performed by nature. *Paleobiology* 3(3):322-324.
39. Straughan, D. 1976. Sublethal effects of natural chronic exposure to petroleum in the marine environment. Final report submitted to The American Petroleum Institute, Environmental Affairs Department. API Publication no. 4280, 119 pp. (mimeo).
40. Warme, J. E., A. A. Ekdale, S. F. Ekdale, and C. H. Peterson. 1976. Raw material of the fossil record, pp. 143-169. *In* R. W. Scott and R. R. West (eds.), Structure and Classification of Paleocommunities. Dowden, Hutchinson, & Ross, Stroudsburg, Penna.
41. Wolff, W. J. 1977. A benthic food budget for the Grevelingen estuary, The Netherlands, and a consideration of the mechanisms causing high benthic secondary production in estuaries, pp. 267-280. *In* B. C. Coull (ed.), Ecology of Marine Benthos. University of South Carolina Press.

## POINT REYES BIRD OBSERVATORY

## Seabird Occurrence in Central California

Two to four censuses have been conducted monthly along transects from the Golden Gate Bridge to the Farallon Islands, a distance of 42 km. Since 1971 about 150 censuses have completed. Boat transport has been supplied by the Oceanic Society. Census effort has been standardized by counting only birds that occur within 300 m and mammals within 800 m of one side of the boat, and by using only trained observers. Within any given year about 30 species of seabirds and 10 mammals have been seen.

These data would be useful to short term environmental assessment projects that include low frequency effort (like that of BLM) because they provide information on variability, both seasonal and annual, in the occurrence of marine birds and mammals off central and northern California. Such variation in numbers can be enormous from one year to another. These data also provide the means to relate beached bird census data to the size of source populations offshore in that all beaches 30 km to the north and south of the transect have been censused since 1974. By integrating information from the two projects, the value of the beached bird census as a tool to assess oil spill impacts can be greatly enhanced. The transect data are in need of computer entry/edit/analysis programs. Two projects, abstracted here, have been in progress since 1971. Both are complementary and analysis of their data would be invaluable to understanding the impact of oil development to seabirds in California waters.

## Seabird Mortality Study

Beaches are walked monthly and the dead birds present are identified and tallied. The cause of death is noted, if apparent (e.g. oiling). In 1971, 8 beaches were censused and since then the coverage has expanded. From 1977 to the present dead birds on about 40 beaches have been censused regularly. Coverage is concentrated from Monterey County to Sonoma County but all 15 California coastal counties are represented.

The data reveal annual and seasonal patterns in seabird mortality. In the event of catastrophes, natural (e.g. food supply) or unnatural (oil spills), they provide a standard against which the magnitude of the mortality can be compared. The data also monitor the impact of oil pollution; currently 10-20% of all dead birds found are oiled. Prevalence of oiling is much higher south of Point Conception, where the coast is much more heavily settled and industrialized. The project is much in need of a computer analysis to allow continual updating of the data base.

July 27, 1979

National Marine Fisheries Service  
Southwest Fisheries Center  
Tiburon Laboratory

PHYSIOLOGICAL ECOLOGY PROGRAM

Our research generally addresses estuarine areas with emphasis on estuarine and anadromous species. Problems in the estuary resulting from man-induced changes will be emphasized; e.g., water releases, diversions, and chronic pollution effects on fisheries resources. Areas currently being studied are underlined. Laboratory-field coordinated studies.

A. Resource Environmental Analysis - Estuarine

1. Selected Factors Affecting Production (Survival and Growth) of Striped Bass Eggs and Larvae. NMFS, SWFC, TDP SWC-060-79-RF-A-1.

- a. Inherent Factors - e.g., genotypic and phenotypic variability.
- b. Natural Environmental Factors - Abiotic and biotic.
- c. Man-induced Changes in Environmental Factors
  - Water Releases) Net Flow
  - Diversions )
  - Inshore habitat alteration: dredging, riprap, docks, etc.

Pollutants - Marine Sanctuaries 202. FY 79.

Petroleum  
Pesticides  
Heavy metals  
Pollutant Interactions

2. Other Fish and Shellfish as research needed.

B. Resource Environmental Analysis - Estuarine long-term chronic pollutant effects.

- 1. Studies of accumulation of pollutants through different adult and larval food chains. FY 80 Increase TDP SWC-103-80-EI-A-1.
- 2. Effects of pollutants on spawning fishes and invertebrates. FY 80 Increase TDP SWC-103-80-EI-A-1.
- 3. Genetic and/or physiological adaptation of organisms to low-level chronic pollution. FY 80 Increase TDP SWC-103-80-EI-A-1.



SUBJECT OR TITLE	AUTHORS	STATUS OF STUDIES AND REVIEW
"Acute toxicity of benzene, a component of crude oil"	Meyerhoff	1974, Fish. Res. Bd. Canada, 32(10): 1864-1866
"The acute toxicity of six monocyclic aromatic crude oil components to striped bass ( <u>Morone saxatilis</u> ) and bay shrimp ( <u>Crago franciscorum</u> )"	Benville, Korn	1977, Calif. Fish & Game Bull. 63(4):204-209
"The effects of benzene on the growth, fat content, and caloric content of striped bass ( <u>Morone saxatilis</u> )"	Korn, Struhsaker, Benville	1976, Fish. Bull. 74:694-698
"Effects of benzene (a toxic component of crude oil) on spawning Pacific herring"	Struhsaker	1977, Fish. Bull. 75:43-49
"Uptake, distribution and depuration of $^{14}\text{C}$ benzene in northern anchovy ( <u>Engraulis mordax</u> ) and striped bass ( <u>Morone saxatilis</u> )"	Korn, Hirsch, Struhsaker	1976, Fish. Bull. 74:531-551
"Uptake, distribution and depuration of $^{14}\text{C}$ benzene and $^{14}\text{C}$ toluene in Pacific herring ( <u>Clupea pallasii</u> )"	Korn, Hirsch, Struhsaker	1977, Fish. Bull. 75:633-636
"Semi-closed seawater system with automatic salinity, temperature, and turbidity control"	Korn	1975, NOAA Tech. Rep. NMFS, SSRF-694-5 pp.
"Gas chromatograph techniques for measurement of monoaromatics using a photoionization detector"	Benville	Manuscript in preparation
"Introduction of monocyclic aromatics into seawater by an outboard engine"	Hirsch, Benville, Whipple	To Laboratory Director for approval
"Review paper on the effects of monoaromatics on fish"	Whipple, Eldridge	First draft manuscript complete
Acute toxicity of the water-soluble fraction of Cook Inlet crude oil to the Manila clam	Nunes, Benville	1978, Mar. Poll. Bull. 9:324-331

SOUTHWEST FISHERIES CENTER  
TIBURON LABORATORY

March 1, 1979

PHYSIOLOGICAL ECOLOGY PROGRAM  
STATUS OF RESEARCH AND PUBLICATIONS  
OIL PHYSIOLOGY  
AND STRIPED BASS TASK

SUBJECT OR TITLE	AUTHORS	STATUS OF STUDIES AND REVIEW
"Determination of fat content in fish with a nontoxic, nonflammable solvent"	Korn, Macedo	1973, J. Fish. Res. Board Can. 30:1880-1881
"A simple apparatus for metering volatile liquids into water"	Benville, Korn	1974, J. Fish. Res. Board Can. 31:367-368
"The respiratory response of juvenile chinook salmon and striped bass exposed to benzene, a water-soluble component of crude oil"	Brocksen, Bailey	1973, Proceedings of the 1973 Conference on Prevention and Control of Oil Spills, pp. 783-91. Washington, D.C.
"Effects of benzene (a water-soluble component of crude oil) on eggs and larvae of Pacific herring and northern anchovy"	Struhsaker, Eldridge, Echeverria	1974, Academic Press. Pollution and Physiology of Marine Organisms, Eds. Vernberg & Vernberg
"Effects of meta-xylene (a water-soluble component of crude oil) on embryos and larvae of Pacific herring"	Eldridge, Struhsaker, Echeverria	On the shelf
"Uptake and depuration of $^{14}\text{C}$ benzene in the rotifer, <u>Brachionus plicatilis</u> "	Echeverria	Under revision after submission to J.Fish.Res.Bd. Can.
"Rate of $^{14}\text{C}$ -benzene in Pacific herring ( <u>Clupea harengus pallasii</u> ) eggs and larvae"	Eldridge, Echeverria, Korn	1978, J. Fish. Res. Bd. Can. 35(6):861-865
"Energetics of Pacific herring ( <u>Clupea harengus pallasii</u> ) embryos and larvae exposed to low concentrations of benzene, a nonaromatic component of crude oil"	Eldridge, Echeverria, Whipple*	1977, Trans. Amer. Fish. Soc. 106(5): 452-461

\*Formerly Struhsaker

SUBJECT OR TITLE	AUTHORS	STATUS OF STUDIES AND REVIEW
"Effects of chronic concentrations of petroleum hydrocarbons on gonadal maturation in starry flounder ( <u>Platichthys stellatus</u> (Pallas))"	Whipple, Yocom, Smart Cohen	1978. Procs. of Conference on Assessment of Ecological Impacts of Oil Spills, June 14-17, 1978, Keystone, Colo. A.I.B.S., pp. 756-806
"Simple continuous-flow systems for dissolving the water-soluble components of crude oil into seawater for acute or chronic exposure of marine organisms"	Benville, Yocom, O'Neill	Submitted to Fishery Bulletin
"Comparative uptake and retention of the water-soluble fraction of Cook Inlet crude oil by the clams ( <u>Tapes semidecussata</u> and <u>Protothaca staminea</u> )"	Smart (co-authors to be determined)	In preparation
"Uptake and retention of water-soluble components of crude oil from food ( <u>Tapes semidecussata</u> ) and water by starry flounder ( <u>Platichthys stellatus</u> )"	Yocom, Benville, Cohen, Smart, Whipple	In preparation
"Oocyte maturation in starry flounder ( <u>Platichthys stellatus</u> )"	Bowers, Whipple	In preparation
"Role of the oil globule in survival and growth of striped bass ( <u>Morone saxatilis</u> ) larvae"	Eldridge, King, Eng, Bowers	1977. Procs. 57th Annual Conf., West. Assoc. of State Game and Fish Commissioners, Tucson, Ariz., 1977, p. 303-313.
"Laboratory studies on factors affecting mortality in California striped bass ( <u>M. saxatilis</u> ) eggs and larvae."	Eldridge, Whipple, Eng, Bowers	1978. In press. Procs. 108th Annual Meeting, American Fisheries Society, Univ. of Rhode Island, Kingston, Rhode Island, 1978.
"Bioenergetics of early life stages of striped bass ( <u>M. saxatilis</u> )"	Eldridge, Whipple Eng	In preparation.
"Transport, retention, and effects of the water-soluble fraction of Cook Inlet crude oil in experimental food chains (RU 389)"	Whipple, Yocom, Benville, Smart, Cohen, Ture	1978. NOAA Tech. Memorandum ERL OCSEAP-1, Marine Bio. Effects of OCS Pet. Dev., Boulder, CO, p. 106-129.

SUBJECT OR TITLE	AUTHORS	STATUS OF STUDIES AND REVIEW
"Survival and development of striped bass ( <u>M. saxatilis</u> ) larvae fed different food rations"	Eldridge, Eng	In preparation
"Histological organogenesis in early life stages of striped bass ( <u>M. saxatilis</u> )"	Bowers, Eldridge, Whipple	In preparation
"Lactate dehydrogenase (LDH) variability in eggs and larvae of striped bass ( <u>Morone saxatilis</u> ) reared in the laboratory"	Whipple, Bowers	In preparation
"A technique for the electrophoresis of single eggs and larvae of the striped bass ( <u>Morone saxatilis</u> )"	Bowers	In preparation
"The effect of inherent parental factors on gamete condition and viability in striped bass ( <u>M. saxatilis</u> )"	Whipple, Benville, Jarvis, Stapp	1979. To be presented at a Symposium on The Early Life History of Fish, Marine Biological Laboratory, Woods Hole, Mass., April 2-5, 1979
"Endogenous energy sources as factors affecting mortality and development in striped bass eggs and larvae"	Eldridge, Eng, Bowers, King	1979. To be presented at a Symposium on The Early Life History of Fish, Marine Biological Laboratory, Woods Hole, Mass., April 2-5, 1979
"Effects of long-term chronic pollution on striped bass ( <u>Morone saxatilis</u> ) in San Francisco Bay-Delta, California"	Whipple, et.al.	In preparation

## Cooperative University Research:

<u>Researcher</u>	<u>Type of Research</u>	<u>Affiliation</u>
Dr. Rick Sitts	Pesticide Toxicity	University of California, Davis
Roger Meyerhoff	Benzene Toxicity; M.S. Thesis	University of California, Davis
Gary Grossman	Gobiid Behavior; Ph.D. Thesis	University of California, Davis
Dr. Joseph Cech	Benzene Effects, Cardio-Vascular Physiology	University of California, Davis
Dr. Howard Bern	Endocrine Physiology	University of California, Berkeley
Nina Hirsch	Benzene Toxicity; M.S. Thesis	University of Pacific
Pepsi Nunes	Benzene Toxicity; M.S. Thesis	University of Pacific
Ross Smart	Benzene Toxicity; M.S. Thesis	San Francisco State University

OCS Project workshop, Santa Rosa May 31 1978. Comments prepared for COAAST. J. W. Hedgpeth

The primary purpose of the meeting was to acquaint <sup>The</sup> county planning office with prospects and problems of offshore oil drilling activity along Sonoma County coast.

The meeting was well organized, informative, and "productive" in striking contrast to the meetings held on estuarine and marine sanctuaries. The Coastal and North Central Regional Commission staff associated with these somewhat unprofitable and time consuming procedures should attend a few of these sessions and learn from them.

About a dozen persons attended the meeting (only governmental agencies are on the mailing list, since, oddly enough, the proceedings are financed by a grant from the U S Civil Service Commission). Individuals, however, were welcome and several ~~in the meeting packet, none present. It is not an information~~ "interested citizens" were present. It was not, however, intended to be an occasion for position statements by governmental organizations or environmental groups.

Most of the essential information is provided in the packet of materials. These were briefly explained, except for an almost two hour non stop presentation by Al Reynolds of Santa Barbara county. What he said about the actual problems in an area with established oil industry and a history of spills and episodes was all interesting and to the point but it was nearly overkill.

In an area such as Sonoma county with only a meagre history of oil drilling, etc., problems can only be anticipated by various hypothetical situations or "scenarios" (one of those repulsively fashionable words now going around). These various scenarios, did not, however, consider the matter of how to take care of oil spills in specific situations and I called attention to the recommendations made in Nova Scotia after the Chedabucto Bay spill in 1970. Apparently no one had heard of this document (pertinent pages herewith) although I believe I had taken up this matter of recognizing critical beaches in the Env Defense Fund critique of the Alaska Pipeline EIR. (operation)

However, we were informed that before oil production there must be provided on shore at appropriate places facilities involving an area for the storage of booms, etc., sheds for equipment etc. to take care of oil spills resulting from oil blow outs, pipeline breaks and tanker spills. At this time such measures are effective only near shore when wind is less than eight knots. It was pointed out that Badega is the only site meeting these conditions on the Sonoma coast (i.e., for the cleanup stand by, not the wind, which is seldom eight knots or less!)

The sedimentary basin off Marin and Sonoma coasts involved in our considerations is the Pt Reyes or Bodega Basin, from about Salt Point south to perhaps Bolinas. Some wells have been drilled in this area and they show traces of oil, but nothing exciting. It may be that they have not hit the right spot. The U S Geological Survey estimates a 60% chance of "finding nothing."

Thus, while there may be oil, it doesn't sound like a very good prospect in view of the rough seas, limited available shore locations for necessary facilities and the anticipated resistance to pipelines to Benicia.

Negative nominations, to be made by local governments, are justified "if there does not seem to be a development and transportation alternative for moving oil from an offshore area consistent with Coastal Act policies," or if the tract is adjacent <sup>to</sup> a sanctuary.

In this context the Marine Life Refuge on Bodega Head, established for study and observation purposes in connection with the University of California's Bodega Marine Laboratory, and the tidal flat study area on the harbor shore, justify the most positively emphasized negative nomination. It is not only the matter of protecting the flora and fauna, but the research invested in it. A single small oil spill could wipe out years of research.

The State of California has also designated the Salt Point Park as an underwater park for subtidal life.

In fact almost all of the Sonoma coast is either parks of various kinds, or esthetic regions incompatible with oil activity, and the estimated low yield (if any) from the Bodega basin suggests that the County Planning Office be encouraged to consider negative nomination for its shoreline. If Sea Ranch does not want people on its shore, they certainly do not want oil. Furthermore, the offshore rigs will have to be lighted at night.

Even after the granting of a lease, it would be ten years before any operation or production could begin. A more real and present danger is from tanker grounding or spills near shore. The gentleman from Santa Barbara expressed worry about a tanker disaster there because there are no tugs, fire boats or helicopters at Santa Barbara, to take care of the tanker if possible. We may be more fortunate than Santa Barbara because heavy tugs are only a few hours away in San Francisco Bay, but on the whole this shore lies vulnerable to tanker mishap.

"Bibliography for planners."

Among the items listed is no 18., a multivolume

"Summary of knowledge of the Central and Northern California Coastal Zone and Offshore Areas."

I do not recommend any agency using taxpayers' money spend \$120.00 (the stated price) for this.

I have examined the biological part of this and it's a hopelessly inadequate mishmash, citing student course reports back to 1932, a popular article in Pacific Discovery and referred research papers as of equal value. It is stated that the compilers "have not located the results" promised in the popular article, yet they cite, a few lines down, some of the actual papers embodying these results. Obviously they had no clear idea of what they were doing.

It appears that the compiler visited Bodega and Dillon Beach and spent a half hour or so with the student reports and a few references scattered on a table, and went on his way.

If the rest of the report is of this caliber, it should be fed to the shredders.

~~XXXXXXXX~~

J. W. H.

A sample of this effort follows:

3. Bodega Bay

The University of California at Berkeley operates the Bodega Bay Marine Laboratory, which has provided greatly to our knowledge of benthic invertebrates of Bodega Bay and the surrounding areas (Bodega Head, Dillon Beach). Much of this information consists of unpublished studies in Zoology



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A SUMMARY OF KNOWLEDGE OF THE CENTRAL AND NORTHERN  
CALIFORNIA COASTAL ZONE AND OFFSHORE AREAS

Volume II

Biological Conditions

Book 1 of 3

Winzler and Kelly Consulting Engineers  
633 Third Street  
Eureka, California 95501



This study was supported by the Bureau of  
Land Management, Department of Interior  
under Contract AA550-CT6-52

August 1977

(Meehan, 1966; Murray, 1957; Baber, 1956). Most importantly, however, "Light's Manual" (Smith & Carlton, 1975) now in its third addition, was revised at the Bodega Bay Marine Laboratory and contains a good account of the invertebrates of the area as well as the central California coast south to the Monterey Peninsula.

The studies of Baber (1956) on subtidal fauna of the harbor and Murray's (1957) analysis of the macrofauna of two mud flats relate to information of the invertebrate fauna of Bodega Bay. (Additional incidental studies of benthic invertebrates occurring in the bay include Bock and Johnson [1967] and Pettichord, in press.) The distribution of fauna due to tidal action and exposure on the rocky coast of Bodega Head was described in an unpublished report by Hedrick (1966). Helfman (1968) collected chitons from both intertidal and subtidal regions to describe epizoic parasites. Armstrong (1965) studied *Macoma nasuta*, *M. secta*, *Prothaca staminea* (*Venerupus*), *Saxidomus nuttalli*, *Mya arenaria*, and *Tresus nuttalli*, in field experiments at Drakes Estero, and Bodega Bay. These studies looked at burrowing limitations in pelecypods and along with the finding that clams tend to be more buoyant than the medium in which they live, he found that clams living in beds subject to surf action are able to regain normal posture if placed in abnormal positions.

#### 4. Bodega Head

The headland known as Bodega Head is subject to frequent study by the students of the Bodega Bay Marine Laboratory. As such, much of the work is unpublished. Barnes (1966) described the invertebrate distribution and population of Bodega Head (unpublished). The following year a final report entitled "A Marine Ecological Survey of the Bodega Head Region" was published (Hand, 1967). This report, while primarily concerned with algae, contains information on settling of invertebrates on nylon strips at Horseshoe Cove and Outlet Cove. Raeder (1932a) described the invertebrate fauna of Horseshoe Bend (see also Bock and Johnson, 1967).

#### 5. Tomales Bay and Tomales Point

Available knowledge of the benthic communities of the Tomales Bay and Tomales Point region is difficult to locate and assess. Alexander (1961, p. 21) wrote concerning the information on Tomales Bay: "Meanwhile, the scientific wealth of the area might be compared to a fine library that has been completely jumbled and unclassified, with books and periodicals scattered helter-skelter on the floor and no record whatsoever of where anything might be found."

In the mid-sixties a governmental program entitled Research Participation for Teacher Training Project was conducted for several summers at Pacific Marine Station. "The Tomales Bay data obtained by the RPTTP program were modest in scope, however, they comprise some of the only collections of ecological data available" (Alexander, 1961). We have not located these results in the literature, however, Alexander stated these data were sent to the University of Chicago to be summarized and published.

An ecological survey of an intertidal flat at Tomales Bay, California was described in an unpublished study by Pitelka and Paulson (1942) and "A Checklist of Marine Invertebrates of the Tomales Bay Region" was published in the research reports of the Pacific Marine Station of the University of the Pacific by Johnson and Juskevics (1965). R. G. Johnson (1959 and 1967) studied the vertical distribution of macroscopic invertebrates at two sites in

Table I-6  
SPECIES LIST FROM STATIONS OFF OF BODEGA BAY (continued)

Station	Location: Bodega Bay	BB-III-1		BB-III-2		BB-II-1	BB-II-2	
Sample		1	2	1	2	2 (only)	1	2
<hr/>								
MOLLUSCA								
<i>Amphineura cf. chaetoderma</i>							-	4
<i>Axionopsida sericata</i>							-	10
<i>Cadulus sp.</i>						1	-	4
<i>Compsomyax subdiaphana</i>							2	2
<i>Cuspidaria glacialis</i>				1	-			
<i>Cylincha attonsa</i>							10	-
<i>Cylincha sp.</i>		5	5				-	1
<i>Dentalium cf. D. Berryi</i>							8	-
<i>Dentalium pretiosum</i>				5	-			
<i>Dentalium sp.</i>				-	2	8		
<i>Epitonium sp.</i>							-	1
<i>Epitonium tinctum</i>							1	-
<i>Haliella sp.</i>						6		
<i>Hiatella arctica</i>							-	1
<i>Macoma cf. M. yoldiformis</i>							2	-
<i>Mitrella sp. (Juv.)</i>							-	1
<i>Mohnia sp.</i>						1		
<i>Mysella sp.</i>							-	33
<i>Nassarius insculptus</i>						1		
<i>Nassarius sp.</i>							-	10
<i>Nucula sp.</i>		-	2					
<i>Nuculana miniata</i>							-	1
<i>Parvilucina tenuisculpta</i>							5	-
<i>Tellina bodegensis</i>				-	3	1		
<i>Tellina buttoni</i>		1	-					
<i>Turbonilla sp.</i>						9	3	-
<i>Vitrinella sp.</i>							1	-
<i>Yoldia ensifera</i>		1	-	3	-			

Tomales Bay. The two stations were White Gulch, a northward facing tidal flat with a slope of 1.8 to 3.5° and Lawsons Flat, a southward facing tidal flat having a slope of 1°. The fauna of both stations were similar. The most common animal was a phoronid, *Phoronopsis harmeri*. The most dominant polychaetes were *Axiiothella rubrocincta*, *Notomastus tenuis*, *Lumbrineris zonata*, and *Boccardia proboscidea*. *Transenella tantilla*, *Macoma nasuta* and *Tresus nuttalli* were the most common pelecypods. Samples were taken with a Van Veen Grab and core samplers. The study concludes that the infauna does not react to tidal fluctuations in water level by appreciable vertical movements in the areas studied, and that there is no evidence of variation of depth of infauna with elevation in the range from 0 to 1 m above sea level. Most species of infauna and about 80% of the individuals occur in the upper 15 cm of sediment. Shulenberger (1970) found *Gemma gemma* to occur in large numbers in the uppermost sediments on the tidal flat of the delta of Walker Creek in Tomales Bay. *Gemma gemma* was able to survive catastrophic burial in up to 230 mm of sand and 57 mm of silt.

Berg (1971) found that the oyster (*Crassostrea*) does not produce successive generations in Tomales Bay because of the failure of the larvae to survive and set. Possible causes of larval mortality are thought to be excessive turbidity, lack of proper food, and blooms of dinoflagellates.

Incidental studies of the Tomales region include: Watling (1970 and 1972), Leonard (1969), Maurer (1967), Narchi (1968) and Berg (1969).

#### 6. Dillon Beach

Benthic invertebrates of the Dillon Beach area have been frequently studied by students of the Pacific Marine Station. Descriptive studies of the area include: A preliminary survey of animals of this sandy beach (Rodgers, 1941) and a comparative study of the fauna of large and small sandy beaches in the region (Brown, 1967). A quantitative distribution of the cumaceans (Gladfelter, 1975) described five new species. E. H. Smith (1962) studied *Cucumaria curata* at the Shell Beach and Sled road areas and found phenotypic color variations between the two areas. Three types of habitats were found: on the leeward side of insular rocks, in mussel beds, and on the underside of rocks toward the lower unit of the mid-littoral zone. The most significant factor affecting the coastal distribution of this species is its brooding habit. Other studies include Hedgepeth (1951), Japss (1936), Chitwood (1960), Hope (1967), Narchi (1968).

#### 7. Point Reyes

We found the literature on benthic invertebrates of the Point Reyes area to consist of a species list of common seashore animals found at Point Reyes (Tierney et al, 1972).

#### D. Point Reyes to Pigeon Point

##### 1. Bolinas Area

The College of Marin maintains a small marine laboratory at Bolinas lagoon near Mill Valley, California. Most of the information located was in the form of unpublished reports. These included Gustafson and Molina's (1968) Ecological Study of Bolinas Lagoon, Fislser's (1958) study of the invertebrate fauna of the salicornia marshes and an interstitial zonation study by Matlock (1958).

industrial and domestic pollutants. Filice's studies are based on samples from 460 stations along the south margin of the waterway between Point San Pablo and Antioch Bridge. McCauley et al (1976) and Nichols (1973) have commented on the conclusions drawn from Filice's work, especially with comparability to more recent works.

The most extensive study of the benthos of San Francisco Bay was conducted by the Sanitary Engineering Research Laboratory (SERL) of the University of California at Berkeley. The SERL study covered most of the bay from the Dumbarton Bridge to the Antioch Bridge with sampling every two months from 1958 to 1964. The findings were reported in four annual reports and eight final reports to CSWPCB (Pearson et al, 1970). Nichols (1973) states, "This study provides the most data on San Francisco Bay invertebrates. Because of difficulties in methodology (both in sampling and species identifications), however, specimen counts and biovolume data must be considered qualitative and used with great caution in comparing with data of subsequent benthic surveys." (See also Brinkhurst and Simmons, 1968.)

In 1970 the State Water Resources Control Board took four replicate ponar grab samples from 8-14 stations in each of six areas in the bay. The six areas were dispersion zones in close proximity to waste outfalls (Powers and Robertson, 1967).

In other studies relating to the bay in general: Miller (1922, 1923) reported on shell variations in the borer *Teredo navalis*, Hanna and Church (1927) on Foraminifera, Bush (1937) on a ciliate in pholads. The marine annelids of the Albatross collection were studied by the late Olga Hartman (1954) and Barnard (1950) discussed occurrence of an amphipod from San Francisco Bay. Steinberg and Jones (1960) and Steinberg (1963a, b, and c) provided information on opisthobranch molluscs, while Brinkhurst and Simmons (1968) have described some of the aquatic oligochaetes of the bay. Many other important studies of the natural history of the fauna of San Francisco Bay are listed in the bibliography.

Shore life of the San Francisco Bay Region and the coast of Northern California were described by Hedgpeth (1962). Some biological and ecological aspects of San Francisco Bay are presented by Harvey (1966) and several agency reports by the USACOE (1975b).

#### b. Studies of the San Francisco Bay Bar and Ship Channel

Yancey and Wilde (1970) describe some of the invertebrate communities on the central California shelf near San Francisco. These data are reportedly based on dried specimens collected by Moore (1965) and the study seems unworthy of further consideration due to non-quantitative methods. Yet it appears to have been the basis of the species lists used by Brown and Caldwell (1971) to assess ecological conditions on the Bay adjacent to the city of San Francisco (Nichols, 1973). Recently, dredging studies of the Bay Bar and Ship Channel have been carried on as part of environmental assessment. Wakeman (1975, unpublished) looked at disposal operations on marine benthos in the region of the bay bar. The impacts of dredging on the open ocean (disposal) and the ship channel are reported by the USACOE (1974a and 1974d).

c. North Central and Bay Studies

Storrs et al (1965) reported on a comprehensive study of the North Central and Lower San Francisco Bay areas. However, the most detailed local studies of the Central Bay area are the now classic studies of Jones in 1954. The study was designed as a baseline for an outfall operation and occupied 65 stations (California Department of Public Health, 1954). In a later and better known study of sampling variation (Jones, 1961b), 30 samples were collected at four stations at a six-week interval over slightly more than a year.

Aplin (1967) reported on the benthic invertebrates collected with a small orange peel grab between Richmond and a location south of the Dumbarton Bridge. According to the review by Nichols (1973), the study identified, counted and measured, and provided data on seasonal abundance of the dominant species. It further stresses the value of benthic invertebrates as a resource, but makes no comparison with previous studies.

d. South Central Bay Region

Information on the relative abundance and sediment preference of the most common species between Rincon Point and Point Avisadero was provided in a study by Dederian (1966). This study suggested that the waterfront had the highest numbers of species and biovolume in the estuary.

Pintler (1958) described single samples from 24 stations in the bay south of the Dumbarton bridge with the intent of determining the effects of sewage effluent on fish and benthos. A paucity of animals in Coyote Creek above Gray Goose Slough was reported (Brown and Caldwell Engineers, 1954), and Vassallo (1969b, 1971) took intertidal samples on the mudflats in the region just north of the San Mateo Bridge. Additional information on the benthic invertebrate communities of the South bay region is contained in the Draft EIS on maintenance dredging (USACOE, 1972) and the Final Composite Environmental Statement (USACOE, 1975c).

e. San Pablo Bay, Suisun Bay, and Delta Areas

In 1953 Smith followed the distribution of *Neanthes lighti* in the Salinas River. Filice (1954a) did an ecological survey of the Castro Creek area in San Pablo Bay, and Ganssle (1966) described the decapods of San Pablo and Suisun Bays as part of the Ecological studies, Sacramento-San Joaquin Estuary, compiled by D. W. Kelly (1966). The fish and wildlife resources of San Francisco Bay and Delta were described in a report by California Fish and Game (1968). In addition, reviews of existing data on benthic invertebrates in the bay were made (Kaiser Engineers, 1968). Kaiser (1969) reported on diversity at 20 stations sampled with an orange peel grab. The effects of dredging and spoil disposal in this region were presented in a special report by U. S. Fish and Wildlife Service (1970). Armstrong et al (1970) discussed a relationship between the waste constituent, toxicity and a measure (diversity) of the structure of a portion of the ecological community, for stations in the Bay Delta area. Pearson et al (1971) provided a summary, conclusions and recommendations of a comprehensive study of San Francisco Bay. Newcomb and Mason (1972), produced an environmental inventory of the North San Francisco Bay-Stockton Ship channel area and the north San Francisco Bay to Suisun Bay area. The Corps of Engineers has studied the effects of dredging on benthic

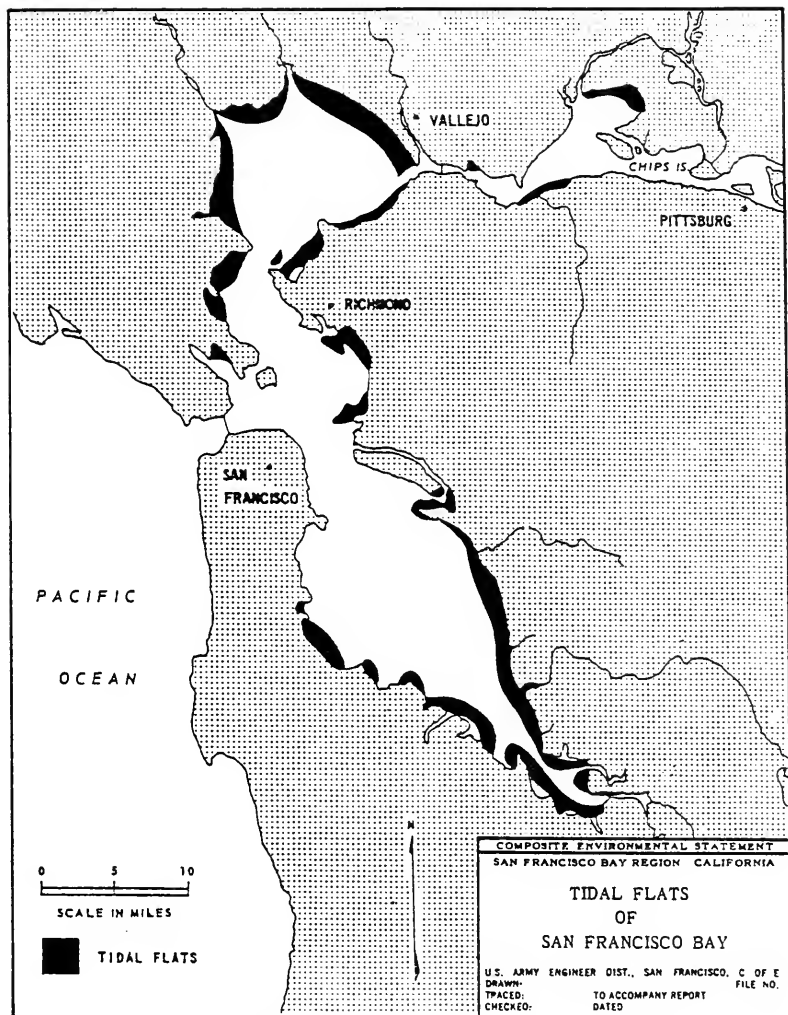


Figure I-3. Tidal flats of San Francisco Bay. (From: San Francisco BCDC, 1966. Marshes and Mud Flats.)

invertebrates in the North San Francisco Bay, Suisun Bay, Petaluma River, Sonoma and Marin Counties (Wakeman et al, 1974; USACOE, 1974c and 1975a).

The most recent compilation of knowledge on benthic invertebrates is perhaps the final Composite Environmental Statement of Maintenance Dredging for the San Francisco Bay Region (U. S. Army Corps of Engineers, 1975a). This statement provides a great amount of summarized and unsummarized information on studies conducted on benthic communities from the perspective of possible effects of dredging and spoiling. The chapter entitled "Biological Characteristics of San Francisco Bay Environs" (Sections 2.185-2.219) includes a discussion of the estuarine ecosystem including maps depicting the Tidal Flat Areas (Figure I-3) which had been prepared by the San Francisco Bay Conservation and Development Commission (1966); a summary discussion of the Bay's clam, mussel, oyster and crab resources; and the charting of the major clam beds previously reported by California Fish and Game (1968) (Figure I-4).

A section on "Historical Abundance of Marshlands [of] San Francisco Bay" depicts the changes in marshlands from 1850 to 1975. It provides little data on the benthic invertebrates beyond recognizing their importance as food for wild fowl. Section 2.244e covers the subtidal benthic habitat (below MLLW) and appears to be a summary of benthic invertebrate studies conducted by the Sanitary Engineering Research Laboratory (SERL) (see Storrs et al, 1966).

The work of SERL concentrates on the Suisun, San Pablo, Central Bay, and Delta regions. Other benthic invertebrate studies conducted for the USACOE are the works of Stanford Research Institute and concentrate on the portions of the bay west and south of Carquinez Strait. There appear to be some discrepancies on the findings of these two studies. The final statement does not list and compare the distribution patterns of the individual species of subtidal bottom invertebrates for each region but does summarize and discuss selected project areas and disposal sites in the bay based on the SERL and SRI studies (USACOE, 1975). Although the report itself does not provide specific details, it does point out some of the discrepancies, and refers those readers desiring more information to the SERL reports (8 volumes), the USFWS special report (1970), and the previously mentioned reports by Aplin (1967), Kelley (1966) and Appendix "D" of the Dredge Disposal Study (USACOE, 1975d).

Restricted to dredging and disposal concerns, the USACOE (1975) report does not mention any previous or "ongoing" benthic invertebrate studies.

The conclusion of this report states, "Despite the taxonomic difficulties, the general qualitative conclusions of these two studies, as well as others such as to the more common subtidal bottom species, general locations, differences between the four sub-bays, and generalized concepts of benthic animal interrelationships are probably valid" (USACOE, 1975f, paragraph 2.246).

The Composite Environmental Statement has been criticized by the scientific and environmentalist community. Some of this criticism is



School of  
Oceanography



Corvallis, Oregon 97331 (503) 754-3504

September 21, 1978

Dr. Joel W. Hedgpeth  
5660 Montecito Avenue  
Santa Rosa, CA 95404

Dear Joel:

Thanks for your note on the BLM review for Winzler and Kelly. Your comments are absolutely correct and I well know the Bodega and Tomales sections are very incomplete and weak. I tried to make it clear in the text that there was a bunch of stuff I knew existed but didn't get in time for the deadline. The melange was required by BLM.

I'm sure you know how difficult it is to be a biological consultant to an engineering firm.

Working for Winzler and Kelly of Eureka was a nightmare beyond belief, to the point of having the president, John Winzler, send his personal envoy to Corvallis to arbitrate some of our disputes in my office. I support your recommendation to the Planning Commission!

Just as incredible were the BLM "scientists," especially Mr. Jay Bason who complained (among other things) about the fact that the California coral reefs were not mapped!

What I didn't understand was your comment on how the few paragraphs on Bodega and Tomales could be doing "great harm," especially when the text implies there was a lot of information we weren't able to locate or assess. Seems as if you or the Planning Commission might use it as a positive aid rather than looking at the harm.

Anyway, it was nice to hear from you and know you are still watching things.

Fond regards,

A handwritten signature in cursive script that reads "Danil R. Hancock".

Danil R. Hancock

DRH:jn

## JOEL W. HEDGPETH

5600 Montecito Avenue, Santa Rosa, California 95404 • Telephone 787-539-1267  
ENVIRONMENTAL AND EDITORIAL ANALYSIS

✱

30 August 1979

House Select Committee on the Outer Continental Shelf,  
Hearing at Pt Reyes, California.

Gentlemen:

Inasmuch as the stated purpose of your hearings of August 29 and 30 is "to determine whether local input is being considered by the Department of the Interior," it is unfortunate that there is no scheduled testimony on the part of mariculture and scientific interests. The University of California maintains a multimillion dollar research establishment on Bodega Head, involving extensive experimental work on the culture of marine organisms as part of its Sea Grant Program. Bodega Head lies within the danger zone of oil exploration and drilling activity as designated on the BLM due west of Bodega Head. Yet this has been overlooked in the preparation of a witness list for this hearing. Nevertheless I believe the committee will in time be advised of the University's concern in this matter.

It is stated in the agenda that "the federally owned Point Reyes National Seashore is protected for a 15-mile radius by the 1978 OCS Act Amendments." The general map publicly distributed by the BLM showing the tracts involved in the OCS 53 lease proceedings has the first scale in nautical miles, the second in kilometers and the last scale in statute miles. It appears from this map that 15 mile nautical mile radius from Tomales Point would include several of the tracts off Bodega Head. This is too close in any event for the safety of the investment in money and research time at Bodega Head, for any consequential oil spill or blowout 11 miles or so west of Bodega Head would reach the shore and also be accumulated in Bodega Harbor and Tomales Bay. Oil spills in these small bays could last there for years and seriously damage the environment.

There are a number of recurring natural phenomena that clearly indicate the trajectory of near shore currents along the Marin and Sonoma county coast. Almost every spring masses of the blue jellyfish like organisms, which lives out in mid ocean, drift ashore with the wind and pile up on the beach in windrows. This tells us that floating objects even in mid ocean frequently reach the shore. The mineral composition of the sandy beaches, especially in Tomales Bay and the great 14 miles beach north of Point Reyes indicates that much of this sand originates in the Russian River drainage.

We have three current regimes on this coast. In late spring and summer the Upwelling Season, driven by strong winds from the northwest, produces a strong near shore flow southward with colder subsurface water coming up at the shore from several hundred feet. Release of oil in this environment at this time would flow southward toward San Francisco and Monterey, and would endanger fishery productivity that depends on the upwelling water.

The second period, referred to as the Oceanic Season is characterized by southward flowing currents, but with eddies and some northeard currents near shore. At this time drifting material may be moved into Tomales Bay or circle around in some

of the eddies for a while before reaching shore.

In winter we have the Davidson Current season, of predominantly northward flowing water near shore, but again with near shore eddies. During this season drift bottles and larval stages of many invertebrates are moved northward, often within a few weeks. Bottle released off Bodega Head have been recovered on the Oregon Coast, for example.

In all these systems, which of course vary in force and persistence from year to year depending on storms, etc., there is some southward component. See the attached diagrams, based in part on Satellite and U-2 photographs. What they tell us is that any considerable oil spill at least as far north as Point Arena, can contaminate the Bodega Marine Laboratory, Tomales Bay and the Pt Reyes National Seashore at least 8 months off the. Any event like the current one off Yucatan would affect the entire California coast or drift north to Oregon, certainly if it is within a dozen miles of the shore, probably under strong onshore wind conditions, much farther out.

Bearing in mind the seismically active nature of this coast, one can ask if the anticipated yields from the leases are worth the very considerable risk.

Very truly yours,

Joel W. Hedgpeth

Attachments:

3 charts of current season from Douglas M. Pirie and Michael J. Murphy,  
1975. California Coastal Processes Study -Aircraft SRT  
Project X-098. NASA, Houston.

Section of BLM chart of OCS 53 tracts.

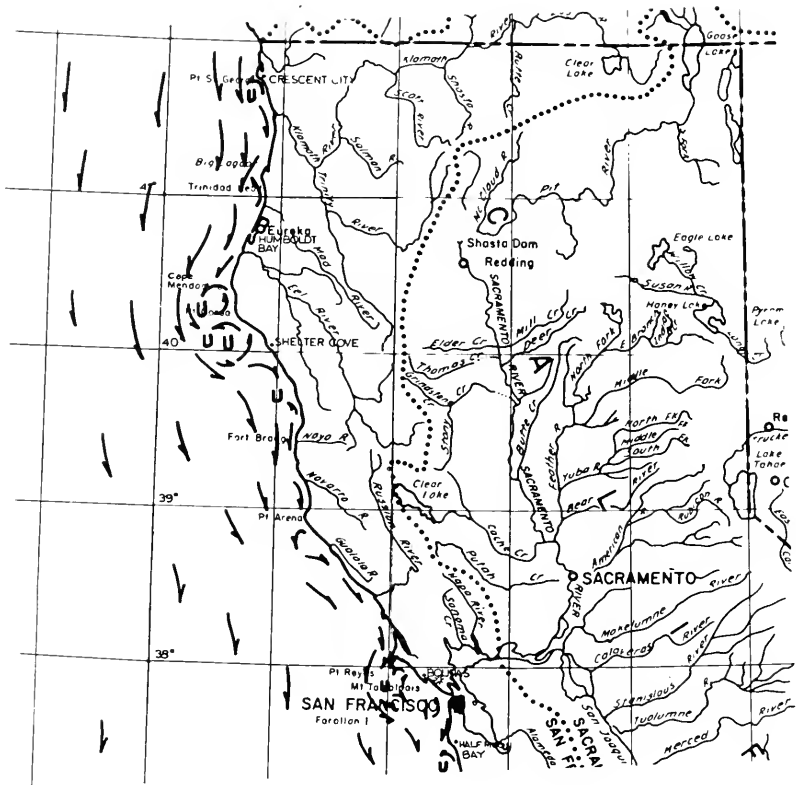


Figure 1-9. Generalized Northern California surface currents for the Upwelling Season.

(March-July)

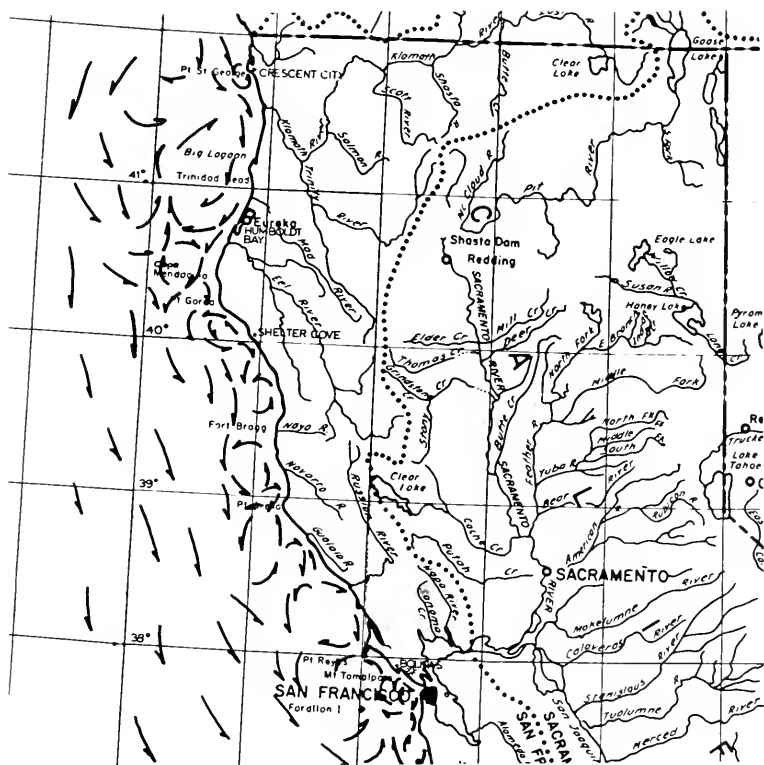


Figure 1-5. Generalized Northern California surface currents for the Oceanic Season.

(July- November)

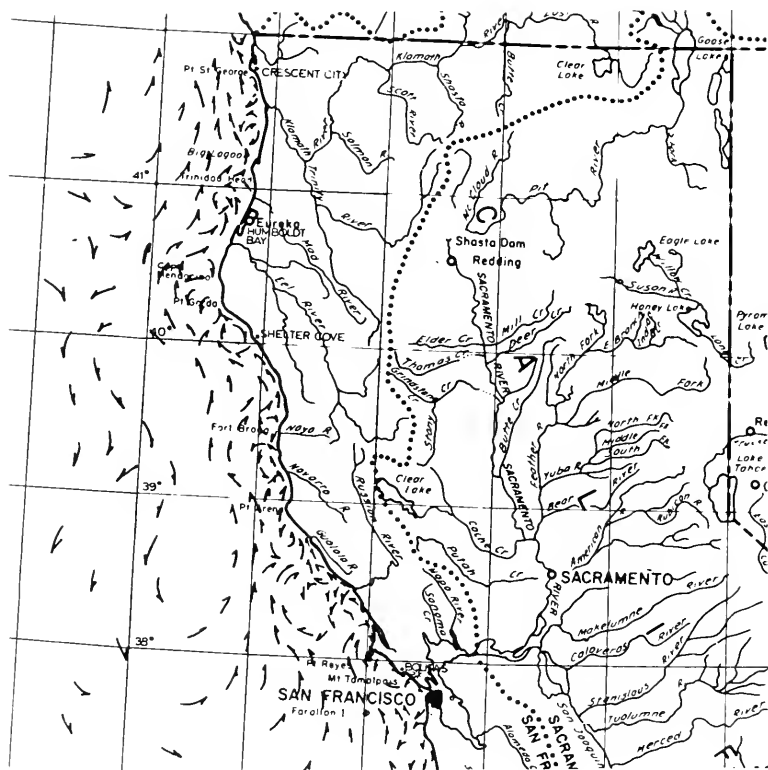
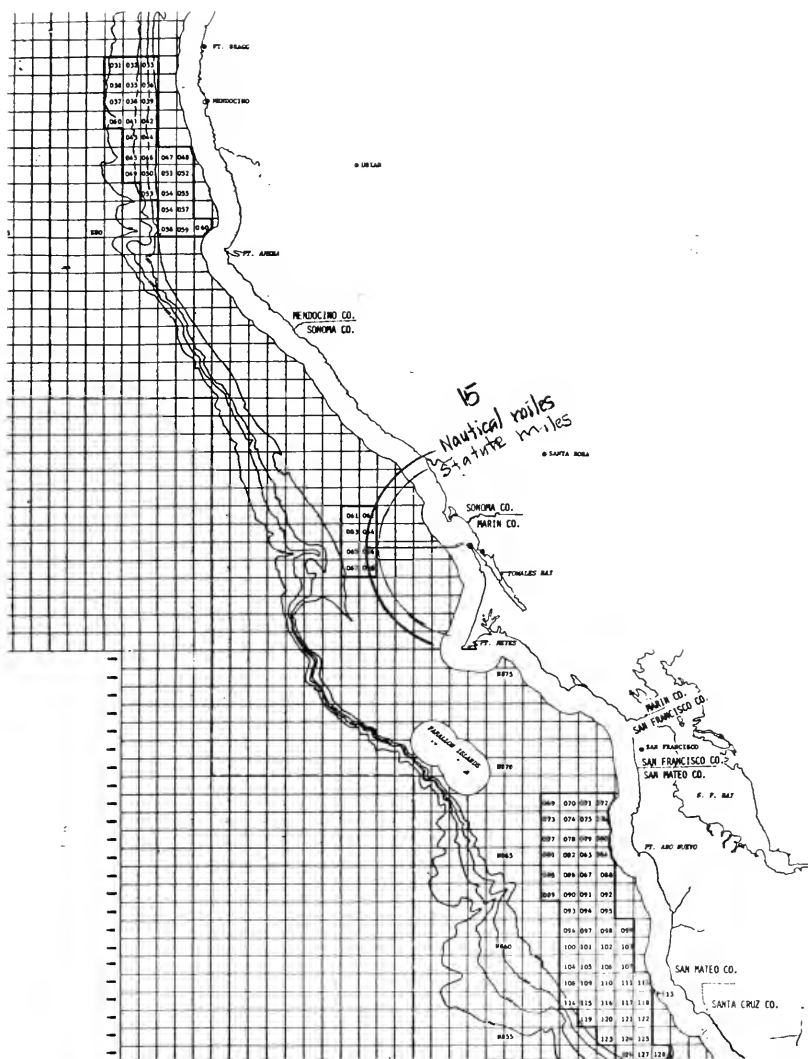


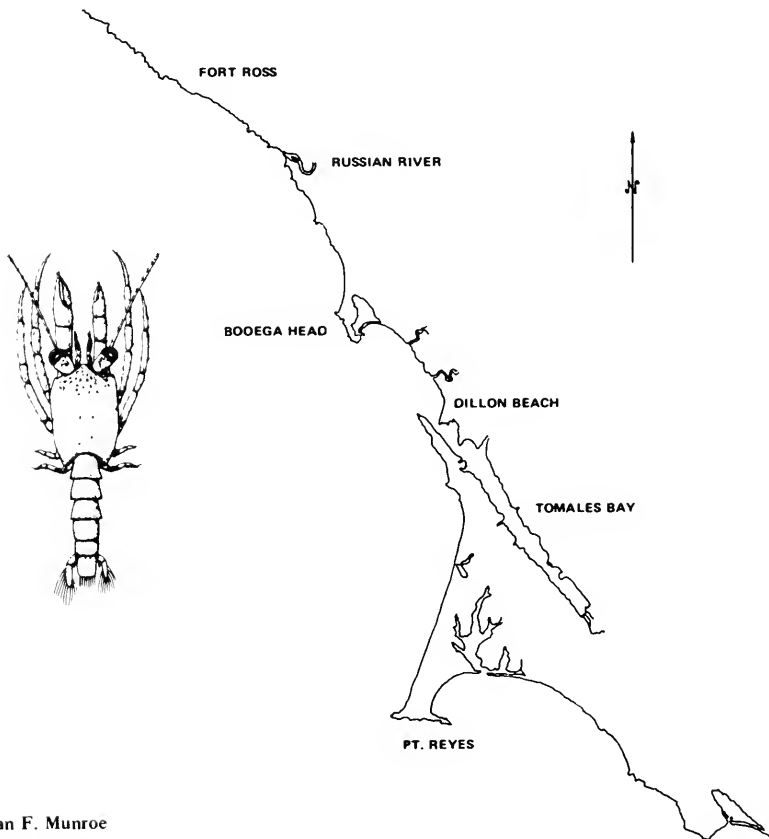
Figure 1-7. Generalized Northern California surface currents for the Davidson Season.

(November - February)



[Committee note: The text of this document was placed in the files.]

## BIBLIOGRAPHY OF MARINE RESEARCH OF TOMALES AND BODEGA BAYS, CALIFORNIA



Jean F. Munroe

With an Addenda by  
Jean F. Munroe &  
James A. Blake

Pacific Marine Station  
University of the Pacific  
Research Report Number 13  
1975

Mr. HUGHES. Thank you, Dr. Herz.  
Mr. Nelson Wolfe of Save Our Shores.



## STATEMENT OF NELSON WOLFE

Mr. WOLFE. Thank you, Mr. Chairman. I am Nelson Wolfe, representing the Save Our Shores organization, from Santa Cruz, Calif. Save Our Shores is a member organization of the Lease Sale 53 Coalition, which includes SOS, the Sierra Club, Friends of the Earth, the Oceanic Society, Friends of the Coast, the Natural and the Resources Defense Council, among others.

Upon notification that this hearing was to be held, other organizations also wished to convey to this committee their concern that the great coastal environmental resources of coastal and northern California are not being adequately protected in the Department of Interior's consideration of offshore oil and gas development.

Some of the additional organizations nationally expressing such concern are the National Wildlife Federation, the National Audubon Society, the Isaak Walton League, the Sierra Club, Friends of the Earth, the Oceanic Society, Defenders of Wildlife, and the National Resources Defense Council. Their combined membership exceeds 4.5 million members.

I have testimony submitted by a number of the State environmental groups, and I will present them for the committee's staff record at this time or after my testimony.

The remainder of my testimony will reflect primarily the views of the Save Our Shores organization, an organization closely affiliated and closely concerned with lease sale No. 53.

I would again like to welcome you to central and northern California, home of one of the most beautiful coastlines in the Nation, in the world.

A combination of coastal resources including international tourism, commercial fisheries, State and Federal parks, developing aquaculture industry, marine research and education facilities, and a unique variety of wildlife habitats, make vital cultural, esthetic and economic contributions to the local, State and national livelihood. Possession of such great economic and esthetic wealth moves the conservation community and the people of California as a whole to be justly concerned that consideration of possible OCS development off our northern coast be done as thoroughly and carefully as possible.

Regrettably, the present process does not reflect these concerns. Those of us confronted with the leasing process are indeed thankful to this committee for the OCS Lands Act Amendments which offer clear direction and articulation of much needed procedural justice and information in regards to protection and development of our coastal resources.

I would like to focus on three areas: One, on the proposed environmental studies program and the process as we have encountered it within the public participation mandated by the act which you have legislated, our experience in the process to date in regards to the data and the study needs. And finally, to the connection of the leasing schedule, as we see it, to a much needed national energy policy.

Yesterday Mr. William Grant, the Pacific OCS office manager for the Bureau of Land Management, stated under questioning that only two studies had been unfunded for this region. I am sorry to say that I find his response to you a bit misleading, in that he cites

only the studies proposed for 1980-1981 in that statement. He failed to mention that in his fiscal year budget for 1979, 10 studies were proposed, 5 of them were funded.

I suggest and will submit, if the BLM does not, a copy of their fiscal year proposal for 1979. And I hope that the committee staff and the members of the committee will thoroughly analyze that document.

It is my sense that the mandated public participation under the OCS Lands Act is designed to insure public participation as a means of insuring public access to the decisionmaking process. Regrettably, our experience in the process to date has only been the experience of an agency paying lipservice to the idea of public participation, and not adequately insuring that the sentiments and the needs of the locales are adequately reflected in the decisions that are being made.

In January of last year the Bureau of Land Management came to us and requested our input into the draft environmental impact study design. It was much to our regret to learn from their environmental studies chief at that time that the priority decisions as to what studies of the 10 studies would be funded had already been made, that in fact the funding had already been received. So in fact our needs, our expressed needs and concerns, were not adequately finding a home in the decisionmaking process, since those decisions had been made at a prior time.

I would like to now talk specifically about those studies.

One of the studies of the 10 that were not funded was a bird toxicity study. The OCS leasing memorandum from the Assistant Secretary to the Secretary states that the Farallon Islands is the largest seabird rookery in the continental United States south of Alaska, yet no bird toxicity study was funded. This is of great concern to us.

The OCS 53 region contains the only sea otter habitat, one of the only habitats, in the world. Yet no sea otter study was funded. A major oil spill would potentially decimate and possibly eliminate the sea otter population.

San Francisco is one of the largest ports on the west coast, and coastal transport traffic is increasing. A major shipping accident involving petrochemicals could be catastrophic for an area of such biological and environmental sensitivity. Yet no shipping and navigational hazard study was funded.

Given the lack of data on active offshore fault zones, particularly off San Mateo and San Francisco Counties, there is not adequate time to determine potential seismic hazards to OCS development in this area.

Dr. Gary Greene yesterday, under questioning from Congressman Burton, admitted that USGS would not have the time to analyze the data after it was collected in the present EIS process.

Little is known of migration routes and potential impacts of OCS development on marine mammals. It is now nearly September and a bird and mammal study has still not been awarded. Six months or less for its completion does not accord adequate time for impact assessment on mammal populations and dynamics. There is not even a single season in which to study a species, which would be in

my estimation the bottom line for a necessary assessment of potential impact on the population.

Next on the studies program, given the frontier nature of this area and the lack of natural seepage therein, more time is needed to assess impacts of chronic low-level oil presence on the ecosystem. Data gaps in this area have not yet been filled. Increasing scientific evidence suggests this to be a major problem. Furthermore, in much of the DOI's analysis, chronic low-level spillage is not dealt with as are potential for oil spills. Such spillage should become a decisionmaking factor and regulatory consideration in the leasing process in all sales with respect to overall timing as well as development.

OCS Lands Act, section 20, No. 3, mandates that such studies be undertaken, and we have repeatedly expressed our concern that such a study be undertaken for our region, particularly in light of the fact that there is little or no natural seepage in the 53 area as there is in the Santa Barbara, in the lease sale 48 area, and the existing Santa Barbara Channel OCS area.

Finally, I would like to talk a little bit about the leasing schedule and its relationship to a national energy policy.

We are seriously concerned with the OCS program and its lack of connection to an integrated national energy policy. We are being asked to compromise the severe environmental risks of our incredibly beautiful and resourceful coastline without an adequate and comprehensive national energy plan.

In certain areas like our own where environmental costs outweigh the developmental benefits, other appropriate alternative technological development should be considered in an integrated fashion. OCS development should not be our only alternative with respect to the national energy need.

Any consideration of OCS leasing must be seen and evaluated with respect to an overall national energy policy. No in-house analysis in the draft schedule is evident in this regard. For instance, the American Petroleum Institute reported in 1974 that there were 21.5 billion barrels of onshore oil in California, excluding secondary recovery techniques, and including lease sale 35. I have the USGS circular here and I can submit it for the record. Should not this avenue be pursued in a comprehensive planning manner prior to our thinking of compromising our most environmentally sensitive areas?

Also, I would like to look a little bit at some of the alternatives that are available to us as a nation, speaking to that as it relates to the OCS program.

For instance, central and northern Californians have demonstrated an ability to conserve water up to 50 percent in their locales in a water conservation program without any local government funds being expended.

A study by the Bechtel Corp. in August 1975 indicates that frontier OCS production costs in capital intensity are between \$10,000 and \$25,000 per daily barrel.

In terms of solar energy, an American Institute of Architects study indicates by 1990 improved design of new buildings and modification of old ones could save one-third of current total national energy use.

The DOW study indicates half of national industrial electric need met by cogeneration by 1985 saving \$20 to \$50 billion in investment, the fuel equivalent of 2 to 3 million barrels of oil per day.

Investments needed to save the equivalent of an extra barrel of oil per day are often \$0 to \$3,500.

I have here a draft copy of a Department of Energy study which has recently been completed and is presently being submitted to the Department of Energy entitled "The Community Level Environmental Impacts of Decentralized Solar Technologies." This study analyzes the potential contribution of decentralized solar technology to the national energy budget as evidenced by the Policy and Review Committee, and it projects that by the year 2000 we could be exceeding the presently projected goal of 20 percent to a figure exceeding that of 36 percent. I will submit this document for the record as well.

Finally, I would like to read a quote from the report of the energy project at the Harvard Business School, which I think has something very interesting to say about the OCS leasing program as it relates to the other potentials for conserving energy in this country. I think it is dismaying to all of us in this country to see the present administration, the President of this country and his advisers, running around as if they were schoolboys getting ready to submit a paper on the day it is due that should have been prepared 10 years in advance. It is absolutely a disgrace in this country.

However, as the Harvard Business School suggests:

If the United States were to make a serious commitment to conservation, it might well consume 30 to 40 percent less energy than it now does and still enjoy the same or an even higher standard of living. That saving would not hinge on a major technological breakthrough, and it would require only modest adjustments in the way people live. The possible energy savings would be the equivalent of the elimination of all imported oil and then some.

Mr. HUGHES. Mr. Wolfe, the balance of your statement is in the record. The submissions, without objection, that you want to put in the record will be received.

Mr. WOLFE. Thank you, Mr. Chairman.

[The information follows:]

#### SUMMARY OF STATEMENT BY G. NELSON WOLFE

##### I. INTRODUCTION

Welcome to Central and Northern California, home of one of the most beautiful coastlines in the world. A combination of coastal resources including international tourism, commercial fisheries, state and federal parks, developing aquaculture industry, marine research and education facilities, a unique variety of wildlife habitats make vital cultural, aesthetic and economic contributions to the local, state and national livelihood. Possession of such great economic and aesthetic wealth moves the conservation community and the people of California as a whole to be justly concerned that consideration of possible OCS development off our northern coast be done as thoroughly and carefully as possible. Regrettably the present process does not reflect these concerns. Those of us confronted with the leasing process are indeed thankful to this Committee for the OCS Lands Act Amendments which offer clear direction and articulation of much needed procedural justice and information in regards to protection and development of our coastal resources.

## II. THE LEASE SALE 53 PROCESS TO DATE

A. Local and state governments as well as public interest groups invested large amounts of time and money in the preliminary tract selection process. Final tract selection primarily reflected resource potential estimates.

B. Studies and Data Needs: The lack of and need for sufficient data has been a consistent cry in the history of Lease Sale 53. Beginning in 1976 requests for more data have come from state and local governments, public interest groups and most recently from BLM PAC OCS office itself. Given the language of the Lands Act Amendments section 20 and the Draft Leasing Schedule, the presently funded and unfunded studies requested for our area are not capable of adequately assessing potential impacts.

1. Memorandum states that the Farallon Islands are the largest seabird rookery in the continental United States, south of Alaska. Yet no bird toxicity study was funded for the EIS in this region.

2. OCS 53 contains one of the only sea otter habitats in the world, yet no sea otter study was funded. A major oil spill would decimate and possibly eliminate the sea otter population.

3. San Francisco is one of the largest ports on the West Coast and coastal transport traffic is increasing. A major shipping accident involving petrochemicals could be catastrophic for an area of such biological and environmental sensitivity. Yet no shipping and navigational hazard study was funded.

4. Given the lack of data on active offshore fault zones, particularly off San Mateo and San Francisco Counties, there is not adequate time to determine potential seismic hazards to OCS development in this area.

5. Little is known of migration routes and potential impacts of OCS development on marine mammals. It is now nearly September and a bird and mammal study has still not been awarded. Six months or less for its completion does not accord adequate time for impact assessment on mammal populations and dynamics.

6. Given the frontier nature of this area and the lack of natural seepage herein, more time is needed to assess impacts of chronic low level oil present on the ecosystem. Data gaps in this area have not yet been filled. Increasing scientific evidence suggests this to be a major problem. Furthermore, in much of the DOI's analysis, chronic low level spillage is not dealt with as are potential for oil spills. Such spillage should become a decision-making factor and regulatory consideration in the leasing process in all sales with respect to overall timing as well as development. OCS Lands Act Section 20 No. 3 mandates that such studies be undertaken.

## III. OCS LEASING SCHEDULE AND NATIONAL ENERGY POLICY

Finally we are seriously concerned with the OCS program and its lack of connection to an integrated National Energy Policy. In certain areas like our own where environmental costs outweigh developmental benefits other appropriate alternative technological development should be considered. OCS development should not be our only alternative with respect to the national energy need.

A. Any consideration of OCS Leasing must be seen and evaluated with respect to an overall national energy policy. No in-house analysis in the draft schedule is evident in this regard. For instance, the American Petroleum Institute reported in 1974 that there were 21.5 billion barrels of onshore oil in California, excluding secondary recovery techniques including (Lease Sale 35). Should not this avenue be pursued prior to further and more environmentally costly OCS development in California?

1. Central and Northern Californians have demonstrated their abilities to conserve as the Monterey County's example testifies.

2. Study by Bechtel Corporation August 1975 indicates Frontier OCS production costs in capital intensity at between \$10,000-\$25,000 per barrel per day.

3. Solar Energy:

a. American Institute of Architects Study indicates by 1990 improved design of new buildings and modification of old ones could save 1/3 of current total national energy use.

b. DOW study indicates half of national industrial electrical need met by cogeneration by 1985 saving 20-50 billion in investment, the fuel equivalent of 2-3 million barrels of oil per day.

c. Investments needed to save the equivalent of an extra barrel of oil per day are often zero to \$3,500.00

d. DOE-Solar Study: Community Level Environmental Impacts of Decentralized Solar Technology. (Submitted to Committee staff).

B. No environmental risks are figured in DOI economic analysis. Potential short and long-term effects of OCS development on tourism, commercial fisheries, marine and human populations must be figured as costs in a necessary cost-benefit analysis of timing and proposed development of OCS. Just as petroleum is a non-renewable resource, so is a damaged marine eco-system. Overall costs to national and international fisheries over a period of years could be of a multi-billion dollar nature.

C. If the national priority to expand domestic production of petroleum must include a willingness to fully and adequately assess the potential costs and to pay the price in time and money, the current state of proposed Lease Sale 53 is absolutely inadequate and incapable of doing this. As a responsible regulatory agency, the Department of Interior should not proceed with consideration of this sale until an adequate studies program can be conducted. Until a first environmental assessment is properly done, consideration of further sales in this area is out of the question. National energy need should not become a national energy panic either at public or governmental levels. Short-term benefits must not become trade-offs for major long-term environmental costs. The urgency in the proposed leasing schedule must be tempered with the wisdom of caution and care. In light of existent data gaps, and the marine systems contributions to many national needs, delays or deletions in scheduling must not be ruled out. In certain areas where risks outweigh benefits, such as the southern Aleutian Shelf and Central and Northern California, it would be wise and prudent to recognize no price tag. Such delay or deletion should not be seen as losses but as contributions towards the national need to learn to conserve the energy it realistically possesses, towards development of safe alternative technologies with the ingenuity which is a symbol of the American Way.

Save Our Shores is most appreciative of and honored by the opportunity to appear before this Committee.

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#### COMMENTS BY KAREN DELANEY ON THE PROPOSED 5-YEAR LEASING SCHEDULE

Our comments will refer to the leasing schedule as a whole whenever possible, but will deal predominantly with the proposed California leases, as we have some understanding of the issues in the California area. Our major concerns are:

##### *I Size of proposed sales*

We feel that the size of the proposed sales is a crucial factor which has apparently been overlooked in the proposed schedules. For example, Lease Sale 53 and the proposed Central and Northern California sale in 1984 each include 5 separate sedimentary basins which stretch over 700 miles of coastline. A sale area that is so large, and so diverse in its geology, climate, biota, and resource potential, makes an adequate assessment of the possible risks and potential benefits of OCS development impossible. How can a single impact statement even begin to address the environmental, social and economic sensitivities of 700 miles worth of unique and pristine coastal areas?

We strongly urge the Secretary to rescale the proposed leasing areas to be comprised of single sedimentary basins wherever possible. This will allow the benefits of any particular development to be weighed directly against the costs to the surrounding environment.

##### *II Timing of sales*

1. *General timing of California sales.*—We feel that placing all California sales in category II does not allow adequate time for a careful and thorough assessment of the impacts of a proposed lease sale. This is particularly true in light of the facts that the California sales are so large, and baseline environmental studies have not been completed in California, and will not be completed for some time.

2. *Timing of lease sale No. 53.*—We are particularly concerned with the timing of lease sale #53. The OCS Land Act Amendments require the Department to complete Environmental Studies on all leasing areas in order to develop information for use in decisions regarding OCS leases.

A. Memorandum states that the Farallon islands are the largest seabird rookery south of Alaska, yet no bird toxicity study has been funded for this area.

B. OCS 53 area contains one of the only sea otter habitats in the world, yet no sea otter study has been funded.

C. San Francisco is one of the largest ports on the west coast, yet no shipping and navigational hazards study has been funded.

D. The coastal areas of San Mateo, Marin and San Francisco counties contain several extremely active fault zones, yet the seismic studies being conducted by the USGS will not be completed by the time the sale is scheduled to take place.

E. Little is known about the effects of OCS development on the many species of marine mammals which migrate along the California coast, yet a marine mammals study will not be completed in time to be included in the DEIS for Lease Sale 53.

F. Data gaps concerning the effects of chronic low level leakage of oil into the marine environment have not been filled to date, and will not be filled by the time the sale of 53 is scheduled.

For all of these reasons, we feel strongly that Lease Sale 53 should be moved back in the schedule to allow more time for a completion of all the necessary studies. We feel that "after the fact" studies are a futile exercise, and an abuse of the intended purpose of baseline studies as stated in the Lands Act Amendments.

### III Criterion for preparation of the leasing schedule

In reviewing the Department's decision memorandum on the proposed 5 year leasing schedule, we find grave inconsistencies between the criterion set out in Section 18(a)(2) of the OCS Land Act Amendments, and the apparent criterion used in designing the proposed schedule. We are particularly concerned with the following areas:

#### Section 18(a)(2)—

(B) An equitable sharing of developmental benefits and environmental risks. We are distressed by the Secretary's statement that environmental risks are seen " \* \* as issues which need to be addressed, whether during pre or post-sale, rather than possible impediments to comprehensive planning for leasing". We believe that the mandate to consider environmental risks as a factor in the comprehensive planning for leasing (i.e. 5 year schedules) is clearly stated in the Land Act Amendments, and cannot be ignored.

(C) The location of leasing regions with respect to, and the relative needs of, regional and national energy markets.

1. There is presently no national energy policy which addresses the issue of a comprehensive plan for a timed development of our national energy resources. Without such an energy policy, a rational development of the OCS which outlines the need for, and potential uses of OCS oil is impossible. Further, the Department's memorandum shows no evidence of an in-house analysis of the national need for OCS oil and gas, or of the national market for this oil, as opposed to any other source of nationally developed oil.

2. The issue of regional markets for high sulfur crude, and regional refinery capacity is not adequately addressed.

(F) Laws, goals and policies of affected states which have been specifically identified by the governor's of such states as relevant matters for the Secretary's consideration.

The state and local governments, and the people of California have consistently made their feelings known to the DOI and BLM in regards to OCS activities in California, and how they relate to the laws, goals and policies of this state. It seems to us that the Department has categorically ignored the wishes of the governments and people of this state. Unfortunately, we have had to resort to Congressional Oversight Hearing (August 1979) and mediation sessions under the Coastal Zone Management Act in order to be heard on OCS related issues.

(G) The relative environmental sensitivity and marine productivity of different areas of the OCS.

While DOI documents indicate that certain environmental factors were examined in each potential sale area, there is no comparison of these factors between lease areas. It is mandated that relative sensitivity of areas be compared, and used in determining the timing and location of scheduled sales.

(H) Relevant environmental and predictive information for different of the OCS.

While some attention was given to existing environment data, we find no evidence that any predictive information and analysis was used in designing the proposed schedules. Predicting the possible impacts of development for various areas is a crucial part of weighing the relative sensitivities of different leasing areas.

We thank the Department for this opportunity to voice our opinions concerning the proposed leasing schedule, and hope that we can continue to work with the Department in order to insure that any OCS development activities are allowed only in those areas where they are proven economically feasible, and environmentally safe.

THE WEST FALMOUTH OIL SPILL: HYDROCARBONS IN THE SALT MARSH ECOSYSTEM<sup>1</sup>

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## ABSTRACT

Marsh surface sediments, cores, and organisms were analyzed for hydrocarbons from one to seven years after the spill in September 1969 of No. 2 fuel oil at West Falmouth, Massachusetts. All organisms analysed showed contamination initially. *Fundulus* were nearly free of oil after one year but *Uca* remained heavily contaminated for at least 4 years. Alkanes disappeared in sediments after about 4 years while heavy aromatics and naphthenes persisted throughout the study.

## INTRODUCTION

The oil barge "Florida" ran aground in Buzzards Bay on the coast of West Falmouth, Massachusetts (U.S.A.) in September, 1969. An estimated 700,000 liters of Number 2 fuel oil leaked from the barge and was driven on-shore by heavy winds. The oil contaminated coastal habitats and subtidal bay areas causing death of many marine and salt marsh organisms. Windrows of dead organisms accumulated on beaches and marshes (Sanders, 1973). Blumer et al. (1970) reported up to 95 percent of the benthic bay animals were dead or dying in heavily oiled areas eight days after the spill. Long term effects of the oil polluted environment on the recolonization of killed areas have been reported in Sanders et al. (1972), Michael et al. (1975), and in Krebs and Burns (1977). Heavily oiled areas had not yet fully recolonized eight years after the original spill.

We report here measurements on the incorporation of petroleum hydrocarbons into various components of the salt marsh ecosystem resulting from this oil spill. Marsh surface sediments, mud cores, animals and plants at West Falmouth (Wild Harbor Marsh) were analyzed one year after the spill and up to seven years later. Preliminary findings were reported in Burns and Teal (1971), detailed analyses of aromatic hydrocarbons in Teal et al. (1978). This report contributes information on the residence time of oil pollution in a New England salt marsh, patterns of incorporation, dissipation and degradation of oil in the salt marsh ecosystem, and the uptake and fate of polluting hydrocarbons in animal and plant tissues. It provides part of the chemical basis for relating hydrocarbons in the environment with animal physiology and survival described in previous publications (Burns, 197a, b; Krebs and Burns, 1977).

## METHODS

*Sample collection*

Marsh organisms were collected in the summer of 1970 from a 30m<sup>2</sup> area of intertidal salt marsh in Wild Harbor. The marsh before the spill was covered by *Spartina alterniflora* and extended from mid tide to mean high tide level over a horizontal distance of about 3m. The collection area extended for about 10m along a tidal creek. Organisms were washed with tap water, packaged in glass jars with aluminum foil-lined caps, and frozen at  $\leq 30^{\circ}\text{C}$  until analysis. We found no dead gulls in the West Falmouth area so we killed one immature that fed in the contaminated marsh and one adult from the Weepeeck nesting colony, about 15 km southwest of West Falmouth in Buzzards Bay. Surface sediments (0-5 cm depth) were collected with a 4.5 cm diameter stainless steel piston corer. Sediment cores, taken with a 6.5 cm diameter plexiglass piston corer, were extruded onto solvent rinsed foil, wrapped and frozen. Water was collected in precleaned glass jugs held below the water surface. Care was taken to avoid disturbance of underlying sediments. All sampling jars and utensils were rinsed with redistilled solvents before use. Control samples were collected at Sippewissett Marsh which opens onto Buzzards Bay 6½ km south of the Wild Harbor Marsh and which was unaffected by the spill.

*Hydrocarbon analysis*

Marsh organisms were thawed, rinsed with ethanol to remove surface contamination, shells (if present) removed, wet tissue weighed, cut into small pieces or ground

<sup>1</sup> Contribution No. 4084 from the Woods Hole Oceanographic Institution. Funds were provided by grants from the Victoria Foundation, Bureau of Commercial Fisheries Fish and Wildlife Grant No. 14-17-007-1128(G), and N.S.F. Grant No. GA-40987.

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with precombusted anhydrous  $\text{Na}_2\text{SO}_4$ , and placed in pre-extracted cellulose thimbles in a Soxhlet apparatus. Tissue samples were analyzed for gulls and eels; whole animals with guts discarded for *Fundulus* and *Uca*; entire animals for the remainder. Stomach and gut removed. Mud cores were partially defrosted, cut to 5 cm lengths, outside layers (which had come in contact with the corer) removed, and cut into small pieces. Samples were extracted 48 hours with methanol. For comparison with other workers some cores were subsequently extracted with 50/50 methanol/benzene mixture. Subsequent procedures were partitioning into pentane, rotary evaporation, copper column for sulfur removal, saponification, and column chromatography. Procedures are detailed in Farrington et al. (1976) and Burns and Smith (1977). Percent recovery of spiked samples measured by total area was 78 to 80% for fuel oil. Blanks showed no procedural contamination.

Some aromatic fractions (from fiddler crabs and sediments) were analyzed on a Finnigan 1015C computerized gas chromatograph-mass spectrometer system. We used the ASTM (1967) method for middle distillates to identify mass fragments from classes of aromatic compounds in the low voltage spectra. The method is not quantitative but useful for determining the presence in an extract of series of mass fragments belonging to various classes of hydrocarbons.

#### Quantification of petroleum derived hydrocarbons

Gas chromatographic (GC) analyses of uncontaminated marsh sediments and organisms were used to identify recently biosynthesized (biogenic) hydrocarbons in the marsh ecosystem. Peaks were identified by coinjection of alkane standards and quantified with external standards. Biogenics were subtracted from the total hydrocarbons in the n-dodecane (C-12) to n-triacontane (C-30) boiling range to give a value of oil hydrocarbons per gram wet weight of sample.

Blumer and Sass (1972) showed that biochemical degradation selectively removed from marine sediments, first the straight chain alkanes and then the branched chains relative to the unresolved complex mixture (UCM) of cyclic and aromatic hydrocarbons characteristic of petroleum contamination. To indicate the relative degree of degradation between samples, we measured the ration of unbranched to isoprenoid hydrocarbons by computing the C-17/pristane or C-18/phytane ratio (whichever had the best resolution in the GC's and least interference from biogenics) and the ratio of phytane to UCM at the same retention index.

### RESULTS

#### Marsh surface

The spilled fuel oil settled onto the Wild Harbor Marsh in a band a few meters wide at the lowest tidal elevations next to the creek edges. Behind this, at higher elevations, was a band of marsh visually untouched by the spill. When we collected our first samples in 1971, 16 months after the spill, there was an inverse correlation between the amounts of oil in surface sediments and plant growth. Areas showing greater than 1 to 2 mg oil/g sediment contained no living higher plants. Initially killed *Spartina marsh*, which by 1971 contained fuel oil concentrations less than this threshold had regrowth of *Salicornia europaea* from germinating seed. *Spartina* regrowth occurred from the edges of killed areas as new roots and rhizomes spread from the living plants. Sediments outside the initially oiled area contained less than 30 ppm oil in 1971 but clearly showed traces of fuel oil in the gas chromatograms.

A series of four samples taken within a radius of 1 meter in the heavily oiled area in December, 1972, contained from 1.1 to 2.2 mg/g oil ( $1.7 \pm 0.4$  mg/g). The vegetation at three of the sites was completely dead. One sample, containing 1.6 mg/g showed limited regrowth of *Salicornia* and *S. patens* the previous summer. Water samples taken the same day contained 3.0 ng oil/g water at high tide over the contaminated muds and 1.0 ng/g in water from the adjacent creek.

The composition of surface mud hydrocarbons changed with time (Table 1). Between 1971 and 1972 there was a gradual decrease in unbranched/isoprenoid ratio but no change in the phytane/background ratio. There was also an increase in percent aromatics hydrocarbons in samples. By May, 1973 (3½ years after the spill) most of the straight chain compounds were missing and the amounts of branched chains had decreased. In November, 1973 the GC's showed most of the straight and branched chain peaks had disappeared leaving the UCM (Fig. 1). Subsequently the percent of aromatic in the hydrocarbons from surface muds decreased. Gas chromatograms of samples taken as late as 1976 were similar to the November 1973 sample and still showed the UCM in concentrations which, in heavily oiled areas, obscured the biogenics. Plant regrowth was accelerated between 1973 and 1975, paralleling the decrease in aromatic hydrocarbons in surface sediments. Regrowth was very uneven over the oiled marsh and we did not have enough or sufficiently detailed

analyses to investigate the patchiness of the recovery. By 1977 only a few dead areas remained, where sediments contained greater than about 1 mg oil/g mud.

### Subsurface sediments

A 1.2 m long sediment core was taken in May, 1971 from the completely dead *S. patens* area. There was 4.3 mg oil/g sediment at the surface (Table 2). Oil had penetrated to at least 70 cm where the series of peaks from plant waxes equaled those of the fuel oil in intensity. Below this depth plant waxes dominated the chromatograms. Oil concentration decreased exponentially with depth of sediments. The unbranched/isoprenoid ratio increased with depth. The small amount of fuel oil present at 115 cm did not follow this pattern and appeared relatively degraded.

A similar distribution was seen in 1972, although amounts were lower. In the 1973 and 1975 cores, no oil was detectable below 20 cm.

### Plants

The green algae, *Enteromorpha clathrata*, was one of the most highly contaminated marsh organisms analyzed (Table 3). The chromatograms showed relatively ungraded fuel oil with boiling range identical to the spilled oil. The red algae, *Polysiphonia fibrillosa*, contained two orders of magnitude less oil than the green algae. From cursory observation the green algae appeared to be far more abundant on the marsh than the red algae, and may have constituted a significant point of entry of hydrocarbons into the marsh food chain. *Spartina* and *Salicornia* took up about the same amount of fuel oil per gram tissue. These two higher plants and algae provide the bulk of plant material available to detritus feeders.

### Animals

The chromatograms from all Wild Harbor animals collected in 1970 showed hydrocarbons of the same boiling range as fuel oil. The oil in animal tissues had a lower unbranched/isoprenoid ratio than that in surface sediments in 1971.

Fiddler crabs showed no significant reduction in the amount of oil in body tissues over the 4 years of analysis. Composition was similar to hydrocarbons present in surface muds. Mass spectral data showed that naphthalenes with 4 and 5 carbon substituents were present in crab tissues 4 years after the oil spill. Other aromatics were present as indicated by their mass fragments but were not resolved from the complex mixture. The sum of ion currents of mass fragments common to aromatics accounted for 80 percent of the total ion current of the 10 percent plus 20 percent benzene/pentane fraction from *Uca* tissues.

*Fundulus* showed great differences in the amount and composition of hydrocarbons in body tissues from 1970 to 1974. By 1974, amounts of hydrocarbons in West Falmouth fish were indistinguishable from controls and most were biogenics. The small amount of petroleum in *Fundulus* in 1974 was present only as a small UCM (Fig. 2).

Herring gulls, *Larus argentatus*, represented the highest level of the food chain that we analyzed. Because of the mobility of gulls and their habit of feeding in places likely to be contaminated by oil (e.g., behind ships and in garbage dumps) we felt that an uncontaminated gull would be difficult to find. But since individual gulls have definite feeding areas, those feeding in the West Falmouth area might show a different pattern of pollution (reflecting the Number 2 fuel oil) than gulls feeding in other areas. This hypothesis was supported by the observation that the gulls feeding on animals killed just after the oil spill were all immatures. Immatures would be in an unfavorable social position in the regular feeding grounds and less selective in their food.

The muscle of the Weepeeck gull contained few hydrocarbons boiling below nonadecane (C-19) (Fig. 3). There were three groups of resolved peaks between C-19 to C-25 range were also found in the West Falmouth gull and were presumed to be of biogenic origin, although we cannot exclude the possibility of a different, more widespread contamination, such as from halogenated hydrocarbons. The muscle of the West Falmouth gull showed the whole range of fuel oil hydrocarbons plus the "biogenics." The brain of this animal showed a large high-boiling UCM. An ultraviolet scan of this extract showed absorption characteristics of single ring aromatics. Any biogenics present were completely masked by this material.

### Discussion

Most of the oil retained in the salt marsh ecosystem after the West Falmouth spill was sorbed into the anoxic marsh sediments. Concentrations were greatest in the surface sediments although the fuel oil penetrated to at least 115 cm in 16 months. Within two years there was a spread of oil onto originally uniled areas. Amounts were less than 50 ppm and the low ratio of unbranched/isoprenoids was

characteristic of degraded oil. Presumably this oil had been on the topmost surface of the nearby oiled marsh and was transported on resuspended particles or dissolved in water as the tide flooded first the oiled and then the unoiled areas. Water over the tide flooded first the oiled and then the unoiled areas. Water over even heavily oiled sediments contained only  $10^{-6}$  (weight basis) the amount of oil in muds.

The 1971 core showed undegraded oil to a depth of 70 cm. The oil at 115 cm in that core was more degraded and probably reached that depth from the surface through a channel in the mud. (There was no evidence in the core of an animal burrow but the possibility cannot be excluded.) The shallower sections showed an exponential decrease of progressively less degraded oil indicating oil was reaching depth by a process of diffusion or small scale mixing. The increase in unbranched/isoprenoid ratio with depth indicated that degradation of the oil ceased once it passed below the surface. All samples below the surface after 1971 contained only degraded oil. Since degradation in anoxic environments is extremely slow if it occurs at all. (Davis, 1968) and salt marsh muds are highly reduced, the originally undergraded oil in the deeper marsh sediments must have been exchanging with surface oil. This is also indicated by the decrease in amount of subsurface oil compared to that in the surface layer after 1971. (Table 2).

Several processes acted simultaneously to disperse oil in the marsh environment as indicated by distribution patterns and changes in chemical composition of oil in surface sediments. Our observations are consistent with those of Blumer and Sass (1972) on Wild Harbor River and Buzzards Bay sediments. Microbial degradation and solution occurred simultaneously but at rates which gave the following picture. The first observed changes were the disappearances of the n-alkanes followed by the branched alkanes. This was seen in the decreasing ratio of unbranched/isoprenoid and by inspection of the GC's. Next was a decrease in phytane/background ratio. In the Wild Harbor Marsh sediments these changes took place in about 4 years with the n-alkanes completely gone in  $3\frac{1}{2}$  years. During this time, the percent aromatic content of the oil in the sediments increased. After the n- and branched-alkanes were gone there was a decrease in the percent of aromatics.

These results are consistent with culture experiments in which microbes isolated from coastal water and sediments oxidized straight and branched chains first when grown on crude oils (Atlas and Bartha, 1973). Aromatics are more resistant to metabolism while the cycloparaffins (naphthenes) are metabolized only very slowly, if at all. Previous field observations and laboratory experiments indicated the low molecular weight aromatics are more water soluble than other classes of hydrocarbons in oil (Blumer and Sass, 1972; Boylan and Tripp, 1971). Thus, the longest lasting residue in the marsh consisted of the higher molecular weight aromatics, naphthenoaromatics and naphthenes comprising the UCM in our analyses of sediment samples.

Our analyses showed the spilled oil was roughly 18 percent n-alkanes, 8% branched alkanes, including the isoprenoids, and 42 percent aromatics. The remaining 32 percent was presumed to be naphthenes. We estimate on the basis of the persistence of the UCM that at least  $1/3$  of the oil sorbed by marsh sediments had a residence time of over 5 years.

Recolonization of the marsh by burrowing animals speeded the exchange and dissipation at depth by opening channels for exchange of oil between sediments and tidal waters. In return, the speeded exchange permitted recolonization of dead areas by more marsh organisms, even though the colonists were killed in the process of burrowing into the highly polluted muds. This process was reported in Krebs and Burns (1977) who followed the return of fiddler crab, *Uca pugnax*, populations up to 1976. They showed a correlation between size and structure of the populations and amount of oil in sediments. Not all areas had fully recolonized after 7 years, despite substantial weathering and degradation of the oil.

All organisms analyzed from Wild Harbor Marsh showed the incorporation of fuel oil hydrocarbons in tissues. We find in these analyses no indication of a food chain magnification among any of the aquatic marsh organisms. For example: mussels feed on detritus derived partly from algae and marsh grasses and had oil levels intermediate to those two food sources. Eels feed on *Fundulus* but had average oil levels in their tissues below those of their food. The only animal we analyzed that showed more oil than its food was the herring gull which contained twice as much as mussels. This data supports that obtained from Sargasso Sea organisms which showed no significant biomagnification of pollutant petroleum hydrocarbons in pelagic marine animals (Burns and Teal, 1973).

Retention of hydrocarbons in animal tissues is a complex function of exposure, mechanisms of uptake, equilibrium of hydrocarbons between body lipids and seawater, and internal biochemical processes affecting the uptake, metabolism and

excretion of hydrocarbons. Our results are consistent with the hypothesis that animals absorb oil from both water and food, lose it by equilibration with water passing over respiratory surfaces, excrete it after possible metabolism, and/or store it in body lipids. For example: *Uca* probably obtain most of their oil by feeding, but lose some by discharge over gills. Fiddler crabs eat mud, detritus and algae and so were exposed to approximately 2 mg oil/g food. Mussels eating detritus and algae were exposed to somewhere between 10 and a few hundred ppm in their food. The same would be true of fish. All were exposed to the approximately 2 ppb in seawater. For mussels and fish, equilibration with hydrocarbons suspended in the water column would initially be the most important process determining body burdens since aquatic animals must extract oxygen from about 10% of water to oxidize one gram of food (Teal 1977). Gulls obtain oil only from their food since they have no gills in contact with seawater. Body burdens would be determined by a balance between intake and excretion. All the animals contained relatively degraded oil which could have entered their tissues either from the water or from surface muds.

The herring gull showed evidence of a partitioning within the body where only selected classes of hydrocarbons (certain aromatics) passed the blood-brain barrier. These are generally the most toxic fraction of residual petroleum. Selective concentration of high boiling substituted aromatics should have implications on the mechanisms of toxicity of oil in birds.

This initial picture of body burden being determined by uptake patterns and equilibration with the polluted environment changed for some animals in subsequent years. An interesting contrast of the varying ability of marine animals to adapt to oil pollution through physiological mechanisms is evident from analyses of *Uca* and *Fundulus*. Both absorbed large amounts of oil in 1969-1970. During the following years they were continuously exposed to the same oil, through more degraded with time.

*Uca* showed no significant difference in body burden of hydrocarbons over the four years. This amount probably represented the maximum concentration they could accumulate and still survive. Biological studies showed that *Uca* were very sensitive to oil in the sediments and suffered severe population reductions, age and sex structure shifts, juvenile mortality and behavioral disruptions (Krebs and Burns, 1977). There was no indication that *Uca* ever developed behavioral or physiological mechanisms for significantly adapting to oil in their environment (Burns, 1976a). Recolonization of the killed marsh was dependent on immigration of adults from contiguous unoil areas until dissipation and microbial degradation processes reduced sediment oil concentrations to tolerable levels.

By 1974, *Fundulus* no longer retained large amounts of oil in body tissues. Despite the potential mobility of fish, studies of *Fundulus* behavior indicate they are very territorial and move little from their home creeks (Lotrich, 1974; Wright, 1972; Butner and Brattstrom, 1960). Yet local populations of these fish appeared much less sensitive to oil in their environment than crabs. Bio-chemical studies in 1974 showed that *Fundulus* had developed high levels of hydrocarbon metabolizing enzymes compared to controls, suggesting they were actively clearing their body tissues of polluting hydrocarbons (Burns, 1976b).

#### SUMMARY

Most fuel oil entering the salt marsh ecosystem after the West Falmouth oil spill was sorbed into the anoxic marsh sediments where it has persisted, and caused long term effects on the behavior, physiology and populations of marsh organisms. Dissipation processes and microbial degradation changed the sorbed oil with time resulting in the disappearance from surface sediments of n- and branched alkanes within 4 years and relative enrichment in aromatics. The most persistent fractions were the high molecular weight aromatics and naphthenes.

All organisms analyzed in 1970 had oil incorporated into tissues. Animal responses to the oil and its changes varied from simple uptake without discrimination against fractions as shown by *Uca*, uptake and selective concentration of certain fractions as shown by the herring gull brain, to discrimination against pollutant hydrocarbons as shown by *Fundulus* after the first year. Since *Fundulus* initially showed uptake without discrimination but later accumulation of mostly biogenics, we believe its later response represents selective metabolism and excretion of pollutants rather than lack of absorption.

The marsh is recovering from the spill in that primary productivity and animal populations are returning to more normal levels as dissipation processes and microbial degradation reduce the oil content of marsh sediments. Recovery was not complete after 8 years. Some sediments contained over 1,200 ppm petroleum hydro-

carbons in 1976. We expect that more persistent components of the oil, the naphthenes and heavier aromatics, will be present in the ecosystem for many years to come.

#### ACKNOWLEDGMENTS

We extend thanks to the following people for help with specific aspects of this work: M. Blumer, J. Sass, O. Zafiriou, J. Farrington, and G. Harvey provided advice on analytical methods. M. Ehrhardt performed the U.V. analysis of the gull brain. N. Frew did the mass spectrometry analyses. D. Masch obtained the seagulls. C. Van Raalte identified the algae. G. Anderson analyzed the 1975 sediment samples.

#### KEY WORDS

Oil spill, hydrocarbons, petroleum, salt marsh, marine pollution.

#### REFERENCES

- American Society for Testing Materials (ASTM). 1967. Standard method of test for hydrocarbon types in middle distillates by mass spectrometry. D2425-67.
- Atlas, R. M. & Bartha, R. 1973 Fate and effects of polluting petroleum in the marine environment. *Residue Reviews* 49, 49-85.
- Blumer, M., Sass, J. Souza, G., Sanders, H. Grassle, F. & Hampson, G. 1970 The West Falmouth oil spill. *Woods Hole Oceanographic Institution Technical Report* 70-44. 32 pp.
- Blumer, M. & Sass, J. 1972 The West Falmouth oil spill. II. Chemistry. *Woods Hole Oceanographic Institution Technical Report* 72-19. 60 pp.
- Boylan, D. B. & Tripp, B. W. 1971 Determination of hydrocarbons in seawater extracts of crude oil and crude oil fractions. *Nature* 230, 44-47.
- Burns, K. A. 1976a Hydrocarbon metabolism in the intertidal fiddler crab, *Uca pugnax*. *Marine Biology* 36, 5-11.
- Burns, K. A. 1976b Microsomal mixed function oxidases in an estuarine fish, *Fundulus heteroclitus*, and their induction as a result of environmental contamination. *Comparative Biochemistry and Physiology* 53, 443-446.
- Burns, K. A. & Smith, J. L. 1977 Distribution of petroleum hydrocarbons in Westernport Bay (Australia): Results of chronic low level input. *Symposium on Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms Proceedings*. D. A. Wolfe ed. Pergamon Press p 442-453.
- Burns, K. A. & Teal, J. M. 1971 Hydrocarbon incorporation into the salt marsh ecosystem after the West Falmouth oil spill. *Woods Hole Oceanographic Institution Technical Report* 71-69. 24 pp.
- Burns, K. A. & Teal, J. M. 1973 Hydrocarbons in the pelagic *Sargassum* community. *Deep Sea Research* 20, 207-211.
- Butner, A. & Brattstrom. 1960. Local movements in *Menidia* and *Fundulus*. *Copeia*, 139-141.
- Davis, J. B. 1968 *Petroleum Microbiology*. American Elsevier Press, Inc.
- Farrington, J. W., Teal, J. M., Medeiros, G. C., Burns, K. A., Robinson, E. A., Quinn, J. G. & Wade, T. L. 1976 Intercalibration of gas chromatographic analyses for hydrocarbons in tissues and extracts of marine organisms. *Analytical Chemistry* 48, 1711-1716.
- Krebs, C. T. & Burns, K. A. 1977 Long term effects of an oil spill on populations of the salt marsh crab, *Uca pugnax*. *Science* 197: 484-487.
- Lotrich, V. A. 1975 Summer home range movement of *Fundulus heteroclitus* in a tidal creek. *Ecology* 56, 191-198.
- Michael, A. D., Van Raalte, C. D. & Brown, L. S. 1975 Long term effects of an oil spill at Wild Harbor, Massachusetts. *Proceedings of Joint Conference on Prevention and Control of Oil Spills*. American Petroleum Institute.
- Sanders, H. L. 1973 Some biological effects related to the West Falmouth oil spill. Background papers Vol. 2 to petroleum in the Marine Environment. National Academy of Sciences Report 1975.
- Sanders, H. L., Grassle, F. & Hampson, G. R. 1972 The West Falmouth oil spill. I. Biology. *Woods Hole Oceanographic Institution Technical Report* 72-20. 23 pp.
- Teal, J. M. 1977 Food chain transfer of hydrocarbons. p. 71-77. Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms. D. A. Wolfe, ed. Pergamon, New York 478 pp.
- Teal, J. M., Burns, K. & Farrington, J. 1978 Analyses of aromatic hydrocarbons in intertidal sediments resulting from two spills of No. 2 fuel oil in Buzzards Bay, Massachusetts. *J. Fish Res. Board Can.* 35: in press.

Wright, J. 1972 *Growth, mortality, production and consumption of a population of the salt marsh killifish, Fundulus heteroclitus*. Master of Arts Thesis. Boston University. 46 pp.

TABLE 1.—CHANGE IN COMPOSITION OF OIL HYDROCARBONS IN WILD HARBOR MARSH SURFACE MUDS WITH TIME—NO BIOGENICS VISIBLE

Sample	PPM <sup>1</sup>	n-alkane Isoprenoid	phytane Background	Percent aromatics
No. 2 fuel oil .....		2.7	1.5	42
Surface muds:				
January 1971 .....	2,700	1.7	1.1	27
July 1972 .....	2,045	0.6	1.2	
July 1972 .....	1,189	0.4	1.5	( <sup>2</sup> )
May 1973 .....	2,660	0.1	0.7	( <sup>2</sup> )
November 1973 .....	2,460	0.0	0.1	35
September 1975 .....	2,171	0.0	0.2	26
July 1976 .....	1,890	0.0	0.0	19

<sup>1</sup> µg hydrocarbons/g wet sediment.

<sup>2</sup> Not determined.

TABLE 2.—CONCENTRATIONS OF PETROLEUM HYDROCARBONS IN MUD CORES FROM WILD HARBOR MARSH 1971 to 1975

Cm depth	1971			1972		1973		1975	
	PPM <sup>4</sup>	Percent <sup>1</sup> biogenic	n-alkane Isoprenoid	PPM <sup>4</sup>	Percent biogenic	PPM <sup>4</sup>	Percent biogenic	PPM <sup>4</sup>	Percent biogenic
0-5 .....	4,307	0	0.7	734	0	2,660	0	2,171	0
10-15 .....	( <sup>2</sup> )	( <sup>2</sup> )	( <sup>2</sup> )	( <sup>2</sup> )	( <sup>2</sup> )	269	44	7.7	77
25-30 .....	72	0	1.4	15.3	29	15.9	100	5.3	85
45-50 .....	15	19	1.8	1.0	78	13.1	100	( <sup>2</sup> )	( <sup>2</sup> )
67-72 .....	2	20	1.4	0.4	92	6.5	100	( <sup>2</sup> )	( <sup>2</sup> )
85-90 .....	1	100	( <sup>3</sup> )8.0	32	15.4	84	( <sup>2</sup> )	( <sup>2</sup> )	( <sup>2</sup> )
115-120 .....	15	88	1.1	( <sup>2</sup> )	( <sup>2</sup> )	( <sup>2</sup> )	( <sup>2</sup> )	( <sup>2</sup> )	( <sup>2</sup> )

<sup>1</sup> Percent of total hydrocarbons attributable to biogenic sources.

<sup>2</sup> Indicates no data.

<sup>3</sup> Ratio affected by biogenics.

<sup>4</sup> µg hydrocarbons/g wet sediment. Ratio of wet to dry sediment was 3.0 ± 0.5.

TABLE 3. OIL CONTENT OF HYDROCARBON EXTRACTS OF ORGANISM TISSUES FROM THE WEST FALMOUTH (WILD HARBOR) MARSH

Organism and date collected	Oil hydrocarbons PPM <sup>2</sup>	n-alkanes isoprenoid
A. Plants:		
"Enteromorpha clathrata" (green macroalgae) (August, 1970) .....	429	<sup>1</sup> 1.06
"Polysiphonia fibrillosa" (red macroalgae) (August, 1970) .....	6.3	<sup>1</sup> 8.25
"Salicornia sp." (marsh succulent) (August, 1970) .....	13.2	<sup>1</sup> 1.44
"Spartina patens" (marsh grass) (August, 1970) .....	15.2	<sup>1</sup> 3.67
B. Animals:		
"Modiolus demissus" (ribbed mussel) (August, 1970) .....	218	0.56
"Auguilla rostrata" (eel liver) (August, 1970) .....	85	0.87
"Auguilla rostrata" (eel muscle) (August, 1970) .....	23	0.54
"Uca pugnax" (fiddler crab):		
(August, 1970) .....	280	0.23
(May, 1972) .....	203	
(August, 1972) .....	259	<sup>1</sup> 0.20
(May, 1973) .....	287	0.19

TABLE 3. OIL CONTENT OF HYDROCARBON EXTRACTS OF ORGANISM TISSUES FROM THE WEST FALMOUTH (WILD HARBOR) MARSH—Continued

Organism and date collected	Oil hydrocarbons PPM <sup>1</sup>	n-alkanes isprenoid
(August, 1973).....	183	0.20
"Fundulus heteroclitus" (marsh minnow):		
(August, 1970).....	75	0.65
(August, 1974).....	9.3	( <sup>1</sup> )
(September, 1974).....	4.6	( <sup>1</sup> )
(September, 1974).....	6.1	( <sup>1</sup> )

<sup>1</sup> Ratio influenced by biogenics.<sup>2</sup> mg/g wet weights.

[From the Geological Survey Circular 730]

## GEOLOGIC APPRAISAL OF THE PETROLEUM POTENTIAL OF OFFSHORE SOUTHERN CALIFORNIA: THE BORDERLAND COMPARED TO ONSHORE COASTAL BASINS

## OIL AND GAS IN ONSHORE CALIFORNIA BASINS

The distributions of oil and gas in California basins on the basis of cumulative production plus demonstrated reserves <sup>1</sup> in known fields is shown in figure 2. The state's total oil production to January 1, 1975, has been 16,753 million barrels, and demonstrated reserves include measured reserves (3,557 million barrels) and indicated reserves (1,349 million barrels) for a current estimate of recoverable oil expected to total 21,659 million barrels (American Petroleum Institute, API, 1975). These estimates include only reserves from known fields; they do not include inferred reserves,<sup>1</sup> reserves in discovered but as yet unproduced fields, future discoveries of new fields, or additional recoveries resulting from technological advances in recovery methods or significant changes in economic conditions.

To evaluate the distribution of petroleum in California basins and specifically the fields in the coastal basins, cumulative production figures to January 1, 1975, have been used rather than current estimates of total recovery or estimates of original-oil-in-place. Reserve figures which are necessary for estimating total recovery (that is, cumulative production plus measured reserves), are published only for entire state (API, 1975) and for those fields with recoveries expected to exceed 100 million barrels of oil (Oil and Gas Journal, 1975a). If measured reserves for all fields were available, a ranking of fields based on estimated recoveries would not be appreciably different from that based on cumulative production, nor would this data change the percentage of total recoverable oil attributed to the largest fields. Published figures show that the 42 largest fields in California (Oil and Gas Journal, 1975a) have reserves of 4,109 million barrels, or 84 percent of the 4,906 million barrels of reserves from all California fields. Original oil-in-place is reported (API, 1975, p. 29-32, p. 75) for the state, but there are no figures for individual fields in California.

Secondary recovery is increasingly important to current oil production in California, with portions of 102 fields undergoing water-flooding and 75 low-gravity fields being stimulated by steam and (or) hot water injection. Secondary recovery by steam now accounts for 34 percent of the present annual production in California (Conservation Committee of California Oil Producers, CCCOP, 1975, p. B). Most of the fields with low-gravity crude contributing to this percentage are in the San Joaquin Valley; the San Ardo field is the major contributor of the fields in the coastal region (CCCOP, 1975, table XXIII-B). The indicated additional reserves of 1.3 billion barrels of oil reported by the American Petroleum Institute reflect the importance of planned and future secondary recovery programs from known fields within the state.

<sup>1</sup> For definition of terms see table of contents at beginning of report.

NORTHERN CALIFORNIA  
OCS ENVIRONMENTAL STUDIES PLAN  
FISCAL YEAR 1979

Prepared By The

Pacific OCS Office  
U.S. Department of the Interior  
Bureau of Land Management  
300 North Los Angeles Street  
Los Angeles, California 90012

Under the Guidelines of the

STUDY DESIGN FOR RESOURCE  
MANAGEMENT DECISIONS: OCS OIL AND GAS  
DEVELOPMENT AND THE ENVIRONMENT

September, 1978



PREFACE

This document is a regional plan for the Bureau of Land Management's (BLM) outer continental shelf (OCS) environmental studies program in northern California for FY 1979 and 80. For this plan's purposes, northern California is defined as extending from Point Conception to the California-Oregon border. Another studies plan has been prepared for the Southern California OCS, covering the area from Pt. Conception to the Mexican border. These plans consider environmental and socioeconomic issues, questions and studies related to federal OCS marine minerals development. BLM's Pacific Outer Continental Shelf Office staff prepared this plan with the participation, review, and comment of state and federal agencies, local governments, the scientific community and the interested public. This regional plan will be revised annually and distributed for public, governmental, and scientific review and comment.

The Regional Studies Plan provides a mechanism for implementing the Bureau of Land Management's (BLM) study design for Outer Continental Shelf (OCS) environmental studies, which is embodied in the document entitled: "Study Design for Resource Management Decisions: OCS Oil and Gas Development and the Environment." The principal objective of this studies program is to "...establish information needed for prediction, assessment, and management of impacts on the human, marine, and coastal environments of the OCS and nearshore areas which may be affected..." (Federal Register 43:3893). The program design attempts to link the information needs of the decisionmaker and the environmental studies that are to be conducted. The design requires identification of the OCS management decisions and leads to development of specific studies to aid in making these decisions. The analytical approach used in this document examines: The management steps, the technologies they allow, the ensuing impacts, relevant management questions, and the use of these considerations in developing individual study designs.

There are many steps in the management of submerged Federal lands for mineral development. Fourteen of them are described within the study design in detail, including: tentative scheduling, call for nominations, tentative tract selection, preparation of draft and final environmental statements, draft Secretarial Issues Document (SID) and preliminary notice of sale, final SID, final tract selection, notice of sale, sale and leases issued, exploration plan and drilling permit evaluation, transportation management plan evaluation, development and production plan evaluation, pipeline permit issuance, and lease termination or expiration. A step may be either a decision itself or the aggregation of information that leads to a decision. Each step can potentially be influenced by study results. Thus, in order to be relevant, studies must serve decisions. Therefore, initiation of the studies must precede the anticipated decision by the time it will take to prepare, execute, and incorporate the results of studies. In addition, attention must be given to providing the studies results in a format utilizable by decisionmakers.

In terms of overall studies timing, the nature and magnitude of impacts, both offshore and onshore, are more accurately predicted once the size of the OCS oil and gas resources is known. Therefore, evaluation of proposed exploration and development plans, with concomitant evaluation of transportation plans, will be an important target for environmental study activity. In addition to direct input of studies results to decisionmaking, existing OCS regulations, operating orders, and procedures provide mechanisms for applying environmental information in the minerals management process, in the form of stipulations, notices to lessees, etc. For example, certain information could be used to exclude tracts from leasing, based on the presence of sensitive biological communities. At the same time, studies on localized transport of potential contaminants by currents could indicate a protective stipulation on rig placement, or a point of discharge that would allow leasing of the tract while still providing for environmental protection.

Each operational phase of OCS oil and gas development implies a specific technology or activity that can be a source of pollutants. The generic relationship between the operational phase and the ensuing potential impacts is a basis for study design. Successive decisions in a specific geographic region more narrowly define and limit the types of activities and technology or equipment that could be employed in subsequent operations. Subjects for study are consequently more specific and more detailed as one proceeds in the decisionmaking process.

Basic management questions further define information needs that the studies must address. At each step of the OCS management process a variety of resource use conflicts may be encountered. The decision to proceed with one resource use, such as OCS oil and gas development, in the presence of other uses of the OCS, will implicitly result in trade-offs between potentially conflicting activities. The purpose of pursuing basic management questions concerning major multiple use conflicts is to make these trade-offs explicit prior to the time the decision is made.

Several potential multiple use conflicts have been defined. The specific uses affected by oil and gas development include commercial fishing, shipping, recreation, social and infrastructure stress, marine and coastal ecological relationships, air and water quality, and archaeological and historic resources. Additional elaboration is provided on a general class of impact producing agents, such as environmental hazards to OCS technology, which could exacerbate contaminant discharges for all these use conflicts. Analysis of these potential use conflicts raises two questions: What is the expected change in benefits derived from man's use of the environment due to the major multiple use conflicts of the leasing proposal? Can any loss be minimized by mitigating measures?

Topics for regional studies are determined by going through a series of logical steps. They are:

- (1) Examining the decisions that are likely to be made in a specific geographic area both in terms of their content and their timing;
- (2) ascertaining which technology the decisions allow either directly or indirectly;
- (3) reviewing the generic impacts associated with the technology;
- (4) considering those potential impacts in a resource management framework by defining appropriate decisionmaker's questions. These questions are then divided into summary or "mid-level" questions and then further subdivided into many more technical questions. Information needed to answer these technical level questions can then be more readily identified;
- (5) identifying what part, or parts, of the information needed is not currently available; and,
- (6) describing the specific topic to be studied.

Plans must be developed for unique regions defined by physical, biological and socioeconomic factors. These Regional Studies Plans are most effective if they are developed for a set of common principles that result from OCS management steps. Ultimately the public issues and scientific details unique to an individual region must be developed by participants from that area. Regardless of the mechanisms used for issue identification, the advantages of utilizing the question/information required approach, as described in the study design, to construct an analytic framework are as follows:

1. The output is truly interdisciplinary. It takes into account issues raised by marine and social scientists.
2. Each faction can see both the interrelationship of their discipline to all other disciplines, and how their contribution is utilized in the decisionmaking process.
3. The proposed framework is flexible in that it is specific enough to indicate what information is needed for each discipline, but general enough to accommodate even finer levels of resolution. For example, one could divide the impact category dealing with oil spills into those oil spills caused by failures in technology (e.g., blowouts, pipeline rupture due to metal fatigue, etc.) and oil spills due to natural hazards.

As described, the study design will be implemented through regional plans. The formulation of this Regional Plan is based on three interrelated considerations:

1. identification of issues through public participation;
2. sorting of these issues by decisions or steps in the OCS management process; and
3. solicitation of scientific opinion on procedures for developing environmental information needed to address these issues.

In conclusion, well conceived studies plans can be fully implemented only if certain additional planning is done. The BLM has a procurement planning process which requires that all actions be scheduled and approved in advance of the beginning of the fiscal year. In doing this planning, factors such as manpower availability and the status of ongoing programs in other Federal agencies weigh heavily in the details of the final implementation scheme. The final step then in the implementation of regional studies plans is the preparation of a procurement scheme and the evaluation of manpower needed to carry it out.

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CHAPTER I. INTRODUCTION

A. Authority. In 1953, The Outer Continental Shelf (OCS) Lands Act (67 Stat. 462) was passed, establishing Federal jurisdiction over the submerged lands of the continental shelf seaward of state boundaries. The Act charged the Secretary of the Interior with the responsibility for the administration of the mineral exploration and development of the OCS, and empowered him to formulate regulations to meet the provisions of the law. The Secretary of the Interior designated the Bureau of Land Management as the administrative agency for leasing submerged Federal lands, and the Geological Survey for supervising production.

In 1969, the National Environmental Policy Act (NEPA) was implemented. This Act requires all Federal agencies to use a systematic, interdisciplinary approach that would ensure the integrated use of the natural and social sciences in any planning and decisionmaking which may have a significant impact on the human environment. The BLM's response to this mandate takes the form of comprehensive Environmental Statements (ES) based upon information compiled during the phases of the Bureau's Planning Process.

Except for the Gulf of Mexico and Southern California, the Federal OCS is an area with relatively little prior marine minerals development. Generally, detailed environmental information in all the OCS areas is lacking. It became necessary to establish an Environmental Studies Program which would actively seek out information gaps, and through a concerted effort of study, provide an adequate data base upon which to make sound management decisions. Since its inception in 1974, this program has evolved into its present concept of providing "information needed for prediction, assessment and management of impacts on the human, marine, and coastal environments of the Outer Continental Shelf and nearshore areas which may be affected by OCS oil and gas activities in such area or region..." (43 CFR 3893).

The 1978 amendments to the OCS Lands Act provide the first legislative mandate for environmental studies in support of offshore minerals development. Title II, Section 209.20 of this Act requires that each study must be commenced at least six months prior to the anticipated sale date, and that the ultimate ambition of the studies program is to predict impacts on the marine, coastal and environment which may result from oil spillage or other pollutants introduced by oil and gas activity. In anticipation of the Amendments' requirements to establish procedures for studies implementation, early in 1978, the BLM commissioned an ad hoc advisory committee of distinguished science-policy representatives to prepare a national study design for continued nearshore and onshore environmental studies. Their program plan adopted by the BLM and the Department of the Interior's OCS Advisory Board on April 29, 1978, mandates the development of studies based upon the information needs of the OCS minerals management

guidelines were used to develop the regional plans. A major tenet of the national document is the recognition that each OCS field office is uniquely capable of coordinating with federal, state, and local agencies and local scientific communities in order to identify regional issues related to OCS minerals development.

#### B. GOALS

BLM's OCS environmental studies goals as defined in Federal Register 43:3893 (January, 1978) and in the national studies design are:

"...to establish information needed for prediction, assessment, and management of impacts on the human, marine, and coastal environments of the Outer Continental Shelf and the nearshore area which may be affected by oil and gas activities in such area or region."

The studies are designed to:

1. "provide information on the status of the environment upon which the prediction of the impacts of Outer Continental Shelf oil and gas development for leasing decisionmaking may be based,
2. provide information on the ways and extent that Outer Continental Shelf development can potentially impact the human, marine, biological, and coastal areas,
3. ensure that information already available or being collected under the program is in a form that can be used in the decisionmaking process associated with a specific leasing action or with the longer term Outer Continental Shelf minerals management responsibilities, and
4. provide a basis for future monitoring of Outer Continental Shelf operations."

In addition, this regional plan's goals are to:

1. Inform the public about the status and future scheduling of BLM's OCS leasing and studies activities in northern California for FY 1979 and 80.
2. Provide a framework for developing studies from critical northern California issues and concerns related to federal OCS leasing and development activities.
3. Identify regional issues and associated decisionmakers' questions related to federal OCS leasing and development decisions for northern California in FY 1979 and 80.



4. Involve the public; local, state, and federal agencies; the scientific community and industry in identifying issues for northern California and in reviewing and commenting on issues, questions, and studies developed for northern California for FY 1979 and 80.
5. Describe a procedure for annual review and update of this regional plan based on continuing public and scientific comments.
6. Identify BLM studies products and results available for northern California and how they can be obtained.
7. Justify BLM's budget to Congress for studies in northern California for FY 1979 and in subsequent years on an annual basis in successive plans.

To place BLM's studies program in context, it is important to realize that the results of environmental assessment and study activities are only one set of facts or information involved in decisionmaking at each step in the OCS management process. For example, decisions are made with the best available environmental information balanced against other issues such as national energy requirements and political concerns. The main purpose of the studies program is to ensure that the environmental information is the best appropriate information available at the time for each management decision step.

C. Approach. For this regional plan, individual studies are generated as a result of a three-step process.

#### 1. Identify Regional Issues

First, the plan identifies regional issues and sub-issues which relate to OCS minerals development for northern California. The fourteen major decisionmaking steps for OCS minerals development, from issuance of the tentative sale schedule through lease expiration or termination, are fully described in Appendix A of this plan. BLM's studies program recognizes two general categories of issues that are common to more than one region and relate to fundamental information gaps recurrent in several decisions.

Examples of such transcending concerns include the effects of oil on aquatic ecosystems, modeling of social and environmental impacts, and oil production in new environments. These nationally-relevant issues will be designed and administered by the BLM's Branch of Environmental Studies in the Washington Office, with the assistance of all field offices and any necessary outside consultation.

The second broad category addresses local or regional issues. These issues are continually identified and coordinated by each OCS field office with the participation of affected state and municipal

governments, regional representatives of other Federal agencies, the local scientific communities, and the public. This latter category includes all issues and related sub-issues germane to a specific region, and may be subject to frequent revision. Issues, by definition, fluctuate with changes in public opinion, political exigencies, acquisition of data, and State or Federal legislation. Sub-issues are those categories within a major decision-level issue which address specific disciplines or areas which relate to interim questions or information needs. Thus, a sub-issue identified a component discipline of a broad issue or one which may apply to a localized area.

This plan recognizes nine specific concerns for the northern California region: air quality, special biological areas and habitats including threatened and endangered species habitats, marine birds and mammals, commercial and sports fishing, recreation and aesthetics, shipping and navigation conflicts, archaeological and cultural resources, infrastructure and social conflicts, and geologic hazards. These concerns are discussed further in Chapter III.

## 2. Translate Issues into Decisionmaker's Questions and Analyze Significance of Questions

Once issues are identified, the second step of the process is to analyze each issue or sub-issue in terms of its significance as a decisionmaker's question. Each concern is reviewed through a matrix of questions in five categories, as follows: Type of Conflict; Cause; Importance to Decision at Hand; Information Base/Existing Conditions; Utility of Information. The result of the review is a ranking of the concerns in order of priority. When assessed in this manner, each issue identified in Step 1 reveals its objective significance, which in turn establishes its relative merit for further investigation by the studies program.

As the National Study Design makes clear, there is a continuum of three levels of information needs related to the decisionmaker hierarchy. At the top level is a requirement of policymakers to recognize those issues which could affect goals, policies, or programmatic schedules. At the other extreme are those highly-technical or scientific questions of impact. Between the two lie issues and questions relating to mid-level management or the local application of higher policies. There is no defineable break between levels. In general, however, the levels are related to policy development, policy implementation, and information collection.

## 3. Identify Study Topics

The significant issues and questions developed in the first two steps must be addressed in terms of scientific and technical feasibility. In some instances, information necessary to address an

issue may already exist, but may be in the wrong format, or may need to be summarized or interpreted. Where information does not exist to address an issue, a study program may be proposed. Because of the direct applicability of each study effort, each study topic may be evaluated in terms of scientific merit and the required timeframe for information needs. This eliminates from active consideration any "basic" research without specific application, or any applied research or development which would obviously require multi-year commitments of time and funding.

After preliminary review of proposed study topics by BLM scientists in the OCS field offices and in Washington, each office is responsible for ensuring sound technical review by leading scientists in the region concerned. Pertinent study topics are circulated to other federal science agencies (U.S. Geological Survey, Fish and Wildlife Service, National Park Service, Environmental Protection Agency, National Oceanic and Atmospheric Administration, etc.) for critical evaluations. The Pacific OCS Office also actively solicits individual reviews by university, state, and industry scientists.

This sequence of detailed reviews will insure that all study concepts merit formal submission. The Bureau's annual research appropriation may then be developed, based upon an existing and planned need.

#### D. Study Program Procurement.

While the Bureau of Land Management encourages all resource agencies at the state and federal levels to use the Regional Studies Plans in identifying their own study programs, all funds administered by the BLM in this program are allocated through a rigorous justification sequence. In general, there are two avenues by which a study program may be contracted: in response to a Request of Proposals issued under the guidelines of the Federal and Interior Procurement Regulations; and in response to an Unsolicited Proposal submitted by a qualified applicant. While a more complete discussion of the procurement process may be found in the National Plan, it may be useful to summarize the steps here.

1. Nearly all the Bureau's environmental studies will be procured as a result of the Request of Proposals (RFP). After a Statement of Work (definition of research objectives, methods, and schedule) is developed, a RFP is issued by the Branch of Contract Operations in Washington inviting technical proposals. Submission requirements are detailed in each RFP. All proposals are reviewed in accordance to a list of evaluation criteria published in the RFP by a select panel of BLM and other federal scientists. The best qualified proposal is awarded the contract.

2. The RFP process notwithstanding, the Bureau also encourages any qualified individual or organization to submit Unsolicited Proposals for consideration on technical and programmatic merits. In order for such a proposal to be acceptable, it must be of outstanding scientific quality and must further demonstrate that the offeror is uniquely qualified to conduct the study. Naturally, it must address one or more specific needs of the Bureau's OCS decisionmaking process. All unsolicited proposals should be sent to the Branch of Contract Operations in Washington.

## CHAPTER II. STATUS AND FUTURE SCHEDULING

A. Past Resource Development. Although the Submerged Lands Act and OCS Lands Act opened the federally-administered Outer Continental Shelf (OCS) to leasing and development in 1953, the first federal oil and gas lease sale off California was not held until 1963. This sale leased a total of 57 tracts in five offshore basins off central and northern California: Eel River, Point Arena, Bodega and Santa Cruz, Outer Santa Cruz, and Santa Maria basins (see Figure 1 and Table 1). These leases were subsequently abandoned after some 20 exploratory wells failed to substantiate any commercial production potential.

Very little is known about these petroliferous basins off the northern California coast. Generally, they are extensions of onshore sedimentary basins, but the strata offshore appear to be thin with poor potential. However, fractured reservoir development possibilities make the area have more potential. There are no recorded offshore seeps in the area. A recent nationwide ranking of industry interest in offshore areas compiled by the Interior Department rated northern California as eleven out of eighteen potential interest areas (Oil and Gas Journal, Aug. 22, 1977).

The State of California has no offshore development in northern California within the state three-mile limit. The State maintains offshore oil and gas sanctuaries off San Luis Obispo, Monterey and Santa Cruz counties (P.R.C. 6871.2(e)) (See Figure 2).

### B. Future Leasing and Development Activities

1. Leasing Activities in FY 1979 and 80. In August, 1977, the Secretary of the Interior issued a proposed OCS planning schedule (Figure 3) which schedules OCS Sale No. 53 in northern California for February, 1981. This scheduling decision step and subsequent decision points in the leasing and development process are described in detail in Appendix A. BLM issued a call for nominations for proposed Sale 53 in November, 1977. This second step in the leasing process for this sale requested comments and positive or negative nominations from industry, governmental agencies, and the general public, for leasing 2,036 prospective blocks totalling 4,347,302 hectares (10,742,183 acres)

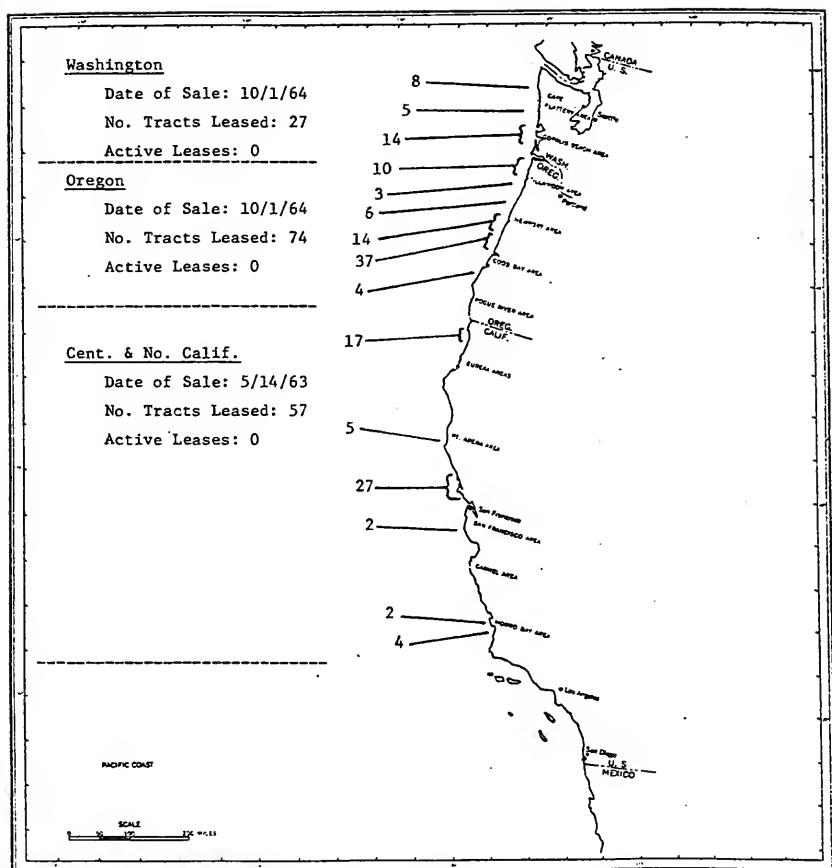


Figure 1.

A summary of historical leasing off the states of Washington, Oregon, and California, north of Point Conception.

Table 1. Federal OCS Leasing History off Northern CaliforniaCENTRAL & NORTHERN CALIFORNIA

Date of Sale: 5/14/63

17	tracts	9-27	nmi.	off Crescent City - Redding Rock Area
5	"	3-9	nmi.	NW of Point Arena
27	"	3-21	nmi.	off Bodega Head - Point Reyes Area (Russian River to Bolinas Bay)
2	"	6-11	nmi.	one (1) 11 nmi. off Pescadero Pt. & one (1) 6 nmi. off Ano Nuevo Pt.
2	"	4	nmi.	off Point Buchon
4	"	9-15	nmi.	off Pismo Beach Area (Pt. San Luis - southern San Luis Obispo County Line)
<hr/>				
57	total tracts			

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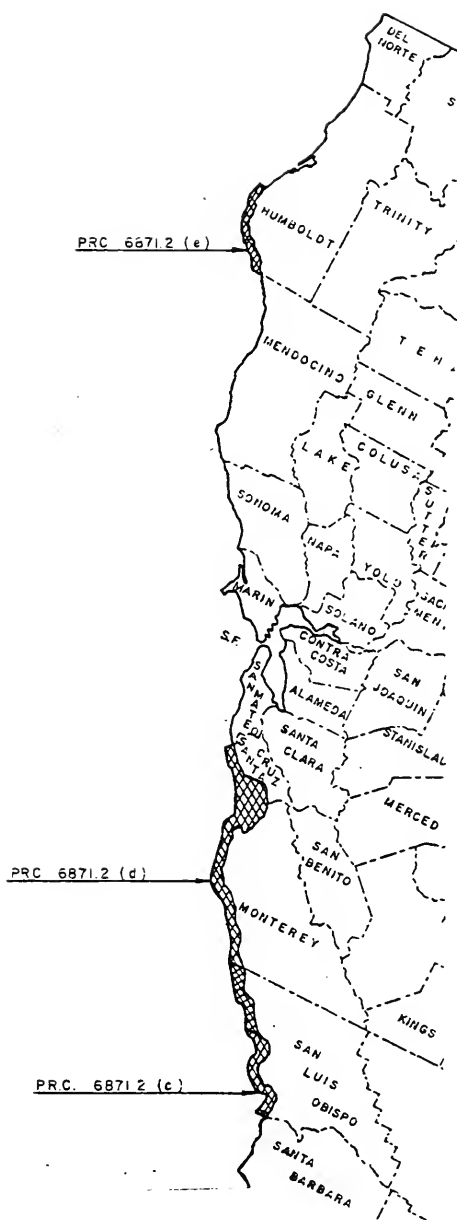


FIG. 2. CALIFORNIA OIL AND GAS SANCTUARIES IN NORTHERN CALIFORNIA





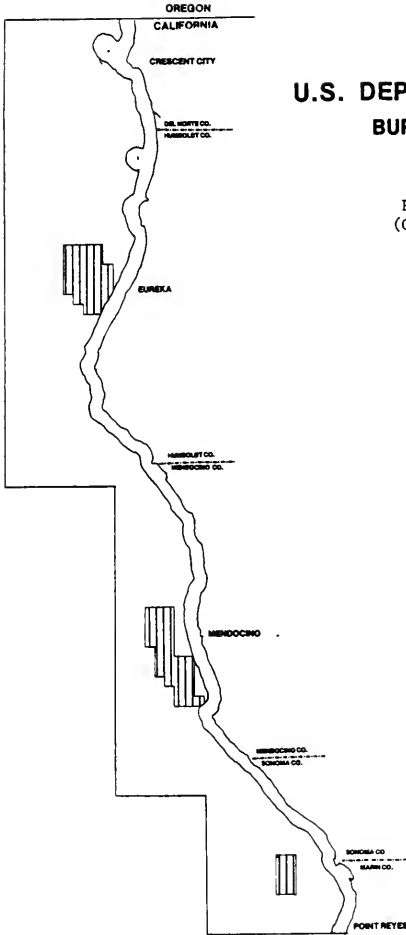
offshore central and northern California. At the same time the Manager, Pacific OCS office, asked for resource reports on available environmental information from federal and state agencies. The nominations and comments were received on June 4, 1978.

The next decision point on the leasing schedule was on October, 10, 1978 when the Secretary of the Interior made an announcement of tentative tract selection for proposed Sale 53. The tentative tract selection was based on the call for nominations responses, available socioeconomic and environmental information presented to the Pacific OCS Manager by staff briefings, information in the resource reports, major resource use conflicts, coordination with State and local governments, and areas of special interest to BLM or USGS based on preliminary oil and gas resource estimates. The BLM Pacific OCS Office Manager and the U.S. Geological Survey (USGS) field office in Los Angeles recommended a tract list to BLM and USGS in Washington. The mutual tract list agreed upon by BLM and USGS in Washington was then submitted to the Secretary of the Interior through the Director, BLM, for the final decision. Figure 4 shows the tentative tracts selected for proposed OCS Sale No. 53. There are 243 tracts comprising 532,588 hectares (1.3 million acres).

The tentative tract selection decision starts the environmental impact statement process, initiates proposed development scenario preparation and commences work on socioeconomic and oil spill trajectory models used in the environmental impact statements. Tract selection also provides the public and governmental agencies with a preliminary tract list for the proposed sale.

The next major steps in the leasing process for proposed Sale 53 are in 1980 with the release of the Draft Environmental Statement in September. Since northern California is considered a frontier area for federal OCS leasing, even though leasing did occur in 1963, the Secretary of the Interior extended the normal timeframe between tract selection and publication of the environmental statements to allow more time for detailed environmental assessment. There will be 1 1/2 years between tract selection and the draft environmental statement and 2 years between tract selection and the final environmental statement for Sale 53. These are considerably longer time intervals than normal between leasing steps (See Figure 5).

The environmental statements are not in themselves decision points, although the statements do contain much of the information upon which the Secretarial Issue Document (SID) is based. The SID is the basic document for the Secretary's decision on final tract selection for any OCS lease sale. An important section of the environmental statements for the SID and the final tract selection decision for the sale is the section that discusses various options to mitigate potential adverse environmental impacts from the proposed OCS development. These options include lease stipulations which have to be agreed upon by BLM, USGS, and the U.S. Fish and Wildlife Service (FWS) and the National Park Service (NPS) before they are recommended to the Secretary of the Interior.



# U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

FIG. 4.  
DES TRACT SELECTION  
PROPOSED OCS LEASE SALE NO. 53  
(Central and Northern California)



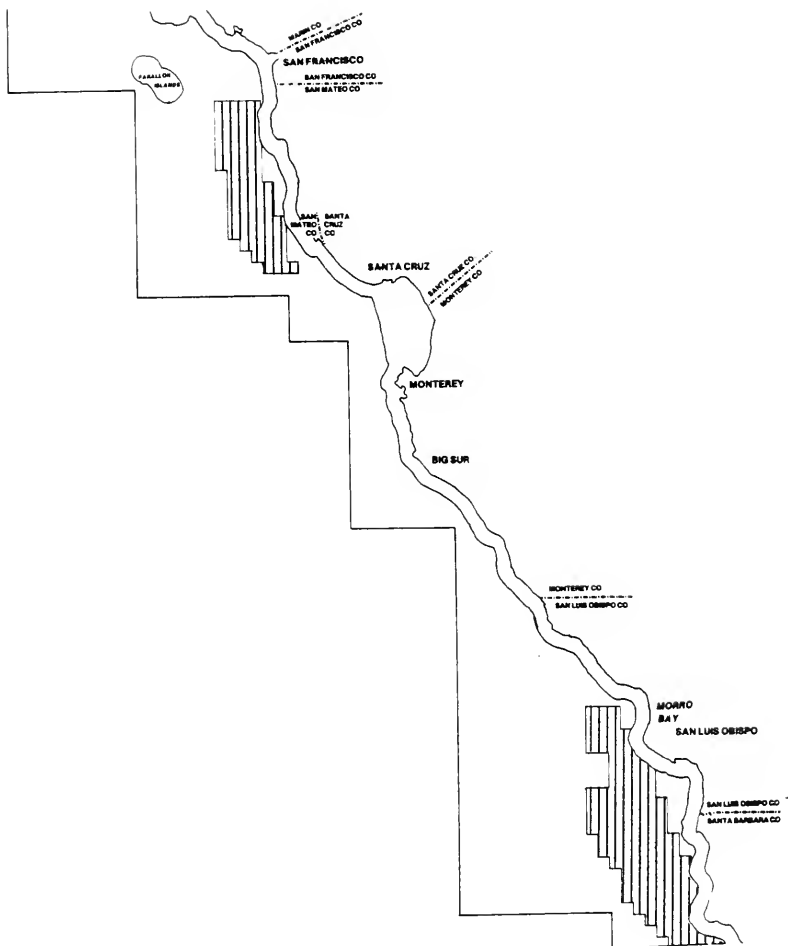
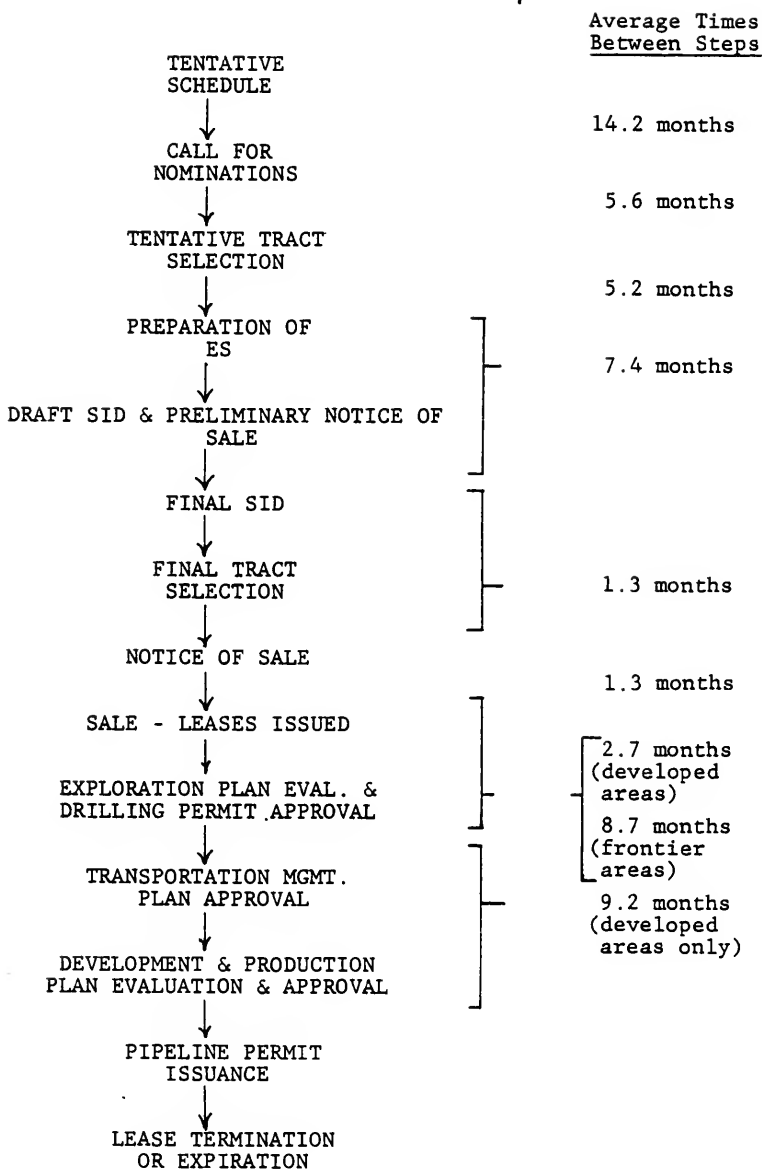


FIG. 5. STEPS IN THE DECISION-MAKING PROCESS



They also include proposed alternatives to the tentative tract selection which have been developed during the detailed environmental assessment through the environmental statement process. For example, certain tracts or areas could be proposed to be withdrawn from this sale to protect critical resource areas. Finally, the options could include recommendations for adding or modifying existing OCS Operating Orders. These options are developed further and expanded in the SID and are coupled with additional socioeconomic, political, and resource information.

According to the OCS planning schedule, the preliminary Notice of Sale for proposed Lease Sale No. 53 is scheduled for November, 1980. The SID will be prepared by BLM field and Washington offices between the Final Environmental Statement release in September, 1980 and before the proposed sale notice. After a 60-day public review and comment period, following the proposed Notice of Sale, the final Notice of Sale will be issued in January, 1981 with the lease sale scheduled for February, 1981.

In summary, the major federal OCS leasing steps in FY 1979 and 80 for proposed Sale 53 are the Draft and Final Environmental Statements. The Draft SID and the Preliminary Sale Notice occur at the end of 1980 with the Final SID, Final Tract Selection, Final Sale Notice, and the lease sale itself taking place in the first few months of 1981. All these leasing decision points should be considered primary targets for studies information in the planning process for FY 1979 and 80.

2. Potential Development Activities for FY 1981 and Beyond. Obviously, the decision to hold an OCS lease sale creates subsequent management decisions such as Exploration Plan approval, Production Plan approval, and Transportation Management Plan approval including pipeline permits (refer to Appendix A and Figure 5 for a general discussion of these major decision points and their timing.) Therefore, this studies plan for FY 1979 and 80 should also consider information needs for the major issues and impacts related to these subsequent potential development decisions. However, at this time, these information needs will be secondary to the information needs required for the pre-leasing decisions discussed above. The following discussion gives a brief overview of the major activities associated with subsequent management decision points.

a. Exploration Plan Evaluation and Drilling Permit Approval. Prior to an OCS lease sale in a general area, oil companies conduct geophysical surveys and geological sampling designed to determine the structure, age, and hydrocarbon potential of the area. Shallow cores, bottom sampling, deep stratigraphic test borings, and information gained by experience in other areas help interpret and define the remote sensing data. The USGS Area Oil and Gas Supervisor in Los Angeles issues permits for these preliminary activities. Exploratory drilling during this preliminary exploratory phase is for geologic information only. The wells are purposely located low on the geologic structure as defined by geophysical data, to minimize the penetration of horizons containing hydrocarbons in commercial quantities.

After the BLM issues a lease to successful bidders, the oil companies must submit an Exploration Plan to the USGS for each leased tract before any exploratory drilling can occur. The Exploration Plan must address any requirements imposed by lease stipulations. The USGS Oil and Gas Supervisor in Los Angeles would approve the Exploration Plan and may grant a permit after review and comment by BLM, FWS, and NPS. The Army Corps of Engineers (COE) administers permits for rig placement and the Environmental Protection Agency (EPA) approves the permits for rig discharges into the ocean. This process can take between four and fifteen months for a frontier area such as northern California, with the average time being about nine months. For OCS lease Sale No. 35 in southern California, some exploration permits were granted within six months of the sale date.

The lessee must submit an Exploration Plan for each tract within five years of signing the lease, or the rights to that tract are forfeited. Exploratory drilling can continue on a tract for any time period, although exploratory drilling on any one tract for longer than five years would be unusual.

Exploratory drilling for a single well generally varies from as little as 30 days to as long as 150 days depending on the nature of the strata to be penetrated, the maximum depth of the well, and the problems encountered during the operation. Exploratory wells are usually drilled from semisubmersible platforms, jackup rigs, or, in deeper water, dynamically-positioned drillships. Generally, the lessees drill a single well in one site, complete tests for commercial production potential, and either abandon the well or cap it and leave it for future production. The drilling rig then moves to a new drilling site. If there are strong indications of petroleum hydrocarbons, the lessee might drill additional wells to delineate the reservoir's size and character. Depending on the number of exploratory wells drilled in a particular field, exploratory rigs might be drilling in a particular reservoir for up to 18 months.

b. Transportation Management Plan Approval. A new Department of Interior policy being developed could call for preparation and approval of a Transportation Management Plan for each OCS lease area. The purpose of the Transportation Management Plan will be to coordinate and implement effective planning for the orderly and timely development of OCS hydrocarbon resources along with environmental protection of OCS and coastal resources and uses.

The plan would consider analysis and recommendations for pipeline corridors and alternatives; identification of appropriate areas for the location of onshore facilities; alternative surface vessel transportation (coordinated with appropriate regulatory agencies); plans for

monitoring construction and operations and follow-up studies that may be required; and stipulations and use requirements applicable to rights-of-way. The working group preparing this plan will have participation from BLM, USGS, the State of California, other Federal agencies with jurisdictional or regulatory responsibilities for OCS operations, industry, local regulatory groups, and public interest groups.

c. Development and Production Plan Evaluation and Approval. If an area appears to have economically significant oil and gas quantities, the lessees prepare development and production plans for each tract and submit the plans to the USGS Oil and Gas Supervisor in Los Angeles for approval. The plans include a technical discussion of production platform design, drilling methodologies, geologic and engineering details, production schedules, transportation plans, and environmental safeguards. Under Secretarial Order 2974 the USGS must obtain review and comment on these plans from BLM, FWS, and NPS. The complete process can take from 2 to 26 months after Exploration Plan approval, with an average of about 9 months for already developed areas. For a frontier area such as northern California, the development and production plan approval would most likely not take place until at least 3 to 4 years after the lease sale, or sometime in 1984 or 1985. For OCS Sale No. 35 in southern California held in December, 1975, the first Development Plan approval for the sale area is targeted for the spring of 1979, or about 3 1/2 years after the lease sale date.

Usually, production platform construction does not begin until sufficient data are available from an oil field to estimate reserves. The actual design and construction of a platform averages about two years from the order date to the delivery date. The minimum delivery time can be as short as one year, but it is usually 3 to 4 years after a sale before a production platform is placed on a tract. After a production platform is set, additional wells are drilled to further delineate the reservoir. The number of wells drilled from a platform and the time necessary to drill the wells depend in part on the structure location and the reservoir size and depth. Each platform has the capacity to drill and operate as many as 50 or more wells, including both production wells and a variety of service wells which increase the field's productivity. Generally, each well takes from 30 to 60 days to complete.

Oil and gas transportation to shore-based facilities is accomplished by pipelines, tankering, barging, or a mix of any of these three options. Economics, the oil and gas field's size and location, environmental safeguards, and compatibility with the California Coastal Act are the primary considerations for transportation planning. As discussed in the previous section, this planning effort could be a joint Federal, State, industry and public responsibility in the future.

In most cases for nearshore tracts, transport to shore is by pipeline. In certain areas, BLM might place stipulations on specific leases requiring all pipelines to be buried, when technically and economically feasible, to prevent hazards to other OCS uses. Pipeline routes are determined by many factors such as water depth, sediment stability and location of other geological hazards, location of petroleum reservoirs, location of onshore facilities, existence of other pipeline corridors and other OCS and coastal environmental considerations. From the time the lessee submits a pipeline permit request to the time the pipeline is completed and in place is generally 2 to 5 years. Frequently, actual production on a specific tract is delayed until enough reservoirs in the area are developed to make it profitable to bring a pipeline ashore. Therefore, production on a limited scale generally does not begin until about 4 to 7 years after the lease sale date, and peak production for a lease area does not occur until 6 to 10 years after the sale date.

For some lease tracts, tankering or barging is the preferred transportation mode. In some cases, mixed oil and formation waste can be piped ashore, processed at an onshore separation facility, and then shipped or barged to refineries in the Los Angeles or San Francisco area for further processing. Some oil could be initially processed offshore at the production platform or at a floating separation facility and then tankered or barged onshore to pipelines or directly to refining facilities. Rather than coming directly into port, tankers can be offloaded at offshore marine terminals such as the multiple buoy systems at Avila Beach in Estero Bay or off El Segundo in the Los Angeles area. Tanker and barge traffic in a given area is regulated by the U.S. Coast Guard which is responsible for navigation safety and establishing the traffic separation lanes for safe vessel movement. Since an oversupply of tankers and barges is available for oil transportation, they would be ready to transport production as soon as production begins, or as early as 3 to 5 years after a lease sale.

#### C. Past and Current BLM Studies Activities in Northern California

1. Literature Survey. BLM recognizes that a considerable amount of study and research on the OCS and coastal environments has been conducted and will continue to be conducted by others. BLM places a very high priority on the synthesis and use of information already obtained. The studies program will continue to search out and evaluate pertinent information conducted by others that can be applied to the leasing decision process. The goal of this approach is to make the best use of the base of knowledge already collected and to avoid duplicating on-going research efforts.

To help obtain the best available information for northern California, BLM contracted with Winlzer and Kelley, Inc. of Eureka, California to prepare a Summary of Knowledge of the Central and Northern California Coastal and Offshore Areas. The summary evaluated information from published and unpublished literature, on-going research projects, and



planned research, and identified data gaps in need of further study. This contract was awarded in September, 1976 and the final document was completed in August, 1977. Their 8,000 page final report is available through the National Technical Information Service (NTIS).

2. Open Meetings. BLM sponsored an open meeting for developing recommendations for studies related to OCS oil and gas development in northern California at San Francisco State University on October 20-22, 1976. This meeting produced a series of Recommendations for Baseline Research in Central and Northern California Relative to Offshore Development. The BLM Pacific OCS Office has a limited number of copies of this document available upon request.

3. Preparation of Preliminary Draft Marine Environmental Studies Plan. Subsequent to the San Francisco Open Meeting, the Pacific OCS Office mailed out over 70 letters to State and Federal agencies, marine research laboratories, academic institutions, and public interest groups throughout central and northern California to obtain information about ongoing research and to establish a contact at each organization for coordination efforts. In addition, the Pacific OCS Office staff held seven local meetings in December, 1976 along the central and northern California coast to further acquaint the participants with BLM's studies program and to discuss the recommendations of the San Francisco meeting. Follow-up meetings with the California State Lands Commission and the California Resources Agency in January, 1977, provided additional discussion on the preliminary studies plan. Appendix C lists the meetings and participants for this early coordination effort.

In January, 1977, Pacific OCS Office Managers and staff met in Los Angeles with representatives from the Conservation and Geological Divisions of USGS to discuss information needs for geology and geological hazards related to offshore development. Small working groups were set up for continued coordination of BLM-USGS activities for studies and research along the west coast of the continental United States.

BLM completed a preliminary draft Marine Environmental Studies Plan for the central and northern California OCS in February, 1977. In August, 1977, Secretary of the Interior Andrus revised the OCS planning schedule. In December, 1977 BLM re-evaluated its OCS studies program in light of various criticisms. With the release of the new national study design in May, 1978, prepared by the BLM Director's ad hoc advisory committee and the submission and approval of this Regional Studies Plan for northern California, BLM will be proceeding with the studies approach and program outlined in this document for FY 1979 and 80. As discussed previously, this Regional Studies Plan will be updated and revised annually.

4. Geologic Hazards Study in Northern California. The BLM signed a Memorandum of Understanding (MOU) in February, 1978 with the U.S. Geological Survey, Menlo Park, to conduct an offshore geologic hazards study in an area extending from Cape Mendocino, California, to Coos Bay, Oregon. The Geological Survey has completed the field work, including

cruises to obtain detailed geophysical and bottom sediment data. The records are being analyzed and the results will be available as an Open File Report, scheduled for publication in the spring of 1979.

### CHAPTER III. MAJOR ISSUES AND MANAGEMENT QUESTIONS FOR OCS LEASING AND DEVELOPMENT IN NORTHERN CALIFORNIA FOR FY 1979 AND 80.

As discussed in the previous chapter, the major leasing steps for OCS Sale 53 for FY 1979 and 80 are the preparation of the draft and final environmental impact statements. These documents in themselves are not major decision steps, but they do contain significant recommendations for mitigating adverse impacts in the form of proposed lease stipulations and alternatives to the proposed action which are the basis for options presented to the Secretary of the Interior in the Secretarial Issue Document (SID). The SID itself, final tract selection, and the sale notices that occur at the end of 1980 and early in 1981 are major decision points in the leasing process that would lead to an OCS sale in February, 1981.

Although these leasing activities and decisions through early 1981 do not in themselves cause any technological impacts during this time period, they do allow later potential development decisions to occur in subsequent years as discussed in Chapter II, Section B. Therefore, the task in this chapter is to identify the major impacts and issues that are generated by subsequent development decisions and technological applications and to develop the significant decisionmaker's questions that will be asked during the pre-sale leasing activities in the timeframe from 1978 to early 1981. In subsequent chapters this process will lead to developing information needs and studies that are relevant to predicting major impacts in the environmental statement process, to developing lease stipulations and potential alternatives for Sale 53, and to providing effective, timely information for the Secretary's management questions in the SID.

A. Major Impacts from Future Decisions and Technologies. Table 2, taken from the national Study Design for Resource Management Decisions, summarizes the major impacts associated with the various OCS exploration and development stages. This table is not intended as an all inclusive impact list. Generally, the impacts described in the table can be grouped into space use or multiple use conflicts; impacts from emissions and discharges into the environment; noise and human disturbance impacts associated with development activities; and socioeconomic effects. The table does not cover the environment's effects on the development activities, such as potential impacts caused by geohazards.

For space-use conflicts and impact-producing agent impacts, the impact's severity is usually related to the activity's intensity and duration in a given area and the activity's proximity to a given use or resource. The projected development scenarios for Sale 53 provided by USGS that will be available in the environmental impact statements will give estimates for a given activity's intensity by area and through time. Obviously, the impacts become easier to predict and more credible once the hydrocarbon resource size and location are known, as well as the

TABLE 2. MAJOR IMPACTS OF OCS DEVELOPMENT FOR VARIOUS OPERATIONAL PHASES

OPERATION PHASE	ACTIVITY/TECHNOLOGY USED	POLLUTANT/AGENT	IMPACTS
1. Geophysical/ Geological Evaluation	A. Seismic Surveying	A. Noise from explosives sparkers, or acoustic	A. Death or impairment of pelagic organisms.
	B. Bottom Sampling (1) Coring (2) Dredging	B. Disturbed sediments.	B. Death or impairment of benthos and infauna.
2. Oil and Gas Exploration	A. Rig fabrication*	A. Location of fabrica- tion facility	A. Waterfront land use competition
		Dredging and filling Fresh water demand Emissions/Discharges Competition for labor	disturbed shore environment Lowered or polluted water table Decreased air and water quality. Manpower costs Economic multiplier
	B. Rig Emplacement (1) Positioning	B. Rig location	B. Interference with military, recreation, shipping or fishing activities
	(2) Anchoring and installation	Disturbed sediments	Death or impairment of benthos and infauna.
* Fabrication of exploratory rigs will probably be done at existing facilities because there is no pressing need to have them constructed in close proximity to exploration drilling, and most construction facilities are under-utilized. Rigs are generally built in one place and towed or sailed to the drilling site, which may lie hundreds or thousands of miles away. Impacts notes are those affecting the existing yards.			

OPERATION PHASE	ACTIVITY/TECHNOLOGY USED	POLLUTANT/AGENT	IMPACTS
2. Oil and Gas Exploration (Continued)	C. Drilling	C. Drill cuttings, drilling muds and fluids.	C. Death or impairment of benthos or infauna from burial. Death or impairment of pelagic organisms from water quality degradation. Interference with fishing activities.
		Machinery noise	
	D. Routine Rig Operations	D. Debris, sewage and effluents	D. Interference with dredge fishing. Interference with fishing from water quality degradation. Decreased air quality
	E. Temporary rig Servicing (1) Logistic bases (2) Service craft	E. (Same as 2.A. above) Rig location	(Same as 2.A. above) Interference with fishing.
		Atmospheric discharges	
3. Field Development	A. Platform Fabrication	A. (Same as 2.A. above)	A. (Same as 2.A. above)
	B. Platform Installation	B. (Same as 2.B. above)	B. (Same as 2.B. above)
	C. Drilling	C. (Same as 2.C. above)	C. (Same as 2.C. above)
	D. Completion--installation of "Christmas tree," riser, and flow lines and connection of wellhead to flow lines.	D. Oil and petroleum compounds  Risers, connections, flow lines	D. Death or impairment of local organisms from water quality degradation. Interference with fishing.

OPERATION PHASE	ACTIVITY/TECHNOLOGY USED	POLLUTANT/AGENT	IMPACTS
3. Field Development (Continued)	E. Routine Rig Operations	E. (Same as 2.D. above)	E. (Same as 2.D. above)
	F. Platform Servicing (1) Permanent logistic bases (2) Service craft	F. (Same as 2.E. above)	F. (Same as 2.E. above)
4. Production	A. Gathering of Fluids	A. Oil	A. Death or impairment of organism from water quality degradation.
	B. Separation of oil/water, oil/gas, and gas scrubbing	B. Refinery location Freshwater Demand Emissions/Discharges Competition for labor	B. Land use competition Lowered or polluted water table. Decreased air and water quality. Economic multiplier
	C. Compressing/Pumping	C. Oil	C. Death or impairment of organisms
	D. Workover	D. (Same as 2.C. and 3.D. above)	D. (Same as 2.C. and 3.D. above)
	E. Routine Platform Operations	E. (Same as 2.D. above)	E. (Same as 2.D. above)

OPERATION PHASE	ACTIVITY/TECHNOLOGY USED	POLLUTANT/AGENT	IMPACTS
4. Production (Continued)	F. Improver Recovery (1) Fracturing (2) High Pressure Rejection (3) Water/Detergent Flooding (4) Polymer Floating (5) Thermal Techniques	F. Chemical residues	F. Death or impairment of organism from water quality degradation.
5. Transportation and Storage	A. Fabrication of Transpor- tation and/or storage Facilities.	A. *	A. *
	B. Storage Facility Emplacement at sea or ashore	B. Storage facility location	B. Interference with military, recreation, shipping, or fishing activities (at sea) Land use competition (ashore) Decreased water quality
		Oil	
*	Fabrication of storage and transportation facilities will probably be done at existing facilities. Impacts associated with this activity are the same as those for any steel fabrication plant.		

OPERATION PHASE	ACTIVITY/TECHNOLOGY USED	POLLUTANT/AGENT	IMPACTS
5. Transportation and Storage (Continued)	G. Pipeline Operations	G. Oil	G. Decreased water quality Death or impairment of organisms Taste tainting Interference with fishing activities from fouled gear.
6. Refining	A. Construction or Expansion	A. Refinery location Dredging and filling Freshwater demand Competition for labor	A. Land use competition Disturbed shore environment. Lowered or polluted water table Manpower costs Economic multiplier
	B. Processing	B. Refinery emissions Waste disposal.	B. Decreased air and water quality

Source: Study Design for Resource Management Decisions (1978)

OPERATION PHASE      ACTIVITY/TECHNOLOGY USED      POLLUTANT/AGENT      IMPACTS

5. Transportation and Storage (Continued)      C. Transfer to Tankers/Barges      C. Space conflicts      C. Interference with military, recreation, shipping, or fishing activities.

Chronic oil discharge from tank cleaning and bilge pumping. Sewage/Effluent discharge Atmospheric discharges Disposal of debris

Decreased air quality Interference with dredge fishing

D. Construction and Emplacement of Pumping Facilities

D. Pumping facility location Competition for labor

D. Land use competition Manpower costs Economic multiplier

E. Routine Tanker/Barge Operations

E. (Same as 5.C. above)

E. (Same as 5.C. above)

F. Pipeline Fabrication and Emplacement

F. \* Disturbed sediments Pipeline locations

F. \* Death or impairment of benthos or infauna. Interference with dredge fishing Waterfront land use competition Manpower costs Economic multiplier

Competition for labor

\* Fabrication of pipe will probably be done at existing facilities. Impacts associated with this activity are the same as for those of any steel fabrication plant.



location of shore-based facilities. This information won't be provided in detail until the development and production plans are submitted. Since the major onshore impacts do not take place until the development and production phases, there is about twice the time available to evaluate onshore impacts as there is to evaluate offshore impacts. Generally, offshore impacts start with the exploration phase (6 to 9 months after the lease sale date) and intensify through the development and production phases.

B. Northern California Issues Related to Major Impacts of Federal OCS Oil and Gas Development. This section lists the major issues identified for northern California related to concerns about major impacts from federal OCS oil and gas development. These were compiled from several sources including:

1. State Information Needs Related to Onshore and Nearshore Effects of OCS Petroleum Development. 1977. Prepared by Office of Coastal Zone Management, NOAA and Bureau of Land Management, DOI.
2. Offshore Oil and Gas Development: Southern California, Vol. I, 1977. Prepared for the California Coastal Commission by the OCS Project Task Force, Office of Planning and Research.
3. California Coastal Plan. 1975. Prepared by the California Coastal Zone Conservation Commission.
4. OCS Sale 53 Lease File. Pacific Outer Continental Shelf Office, BLM, Los Angeles. Includes public and governmental comments and concern including responses to the Call for nominations for Sale 53.
5. Recommendations for Baseline Research in Central and Northern California Relative to Offshore Resource Development. 1977. Prepared for BLM by San Francisco State University.
6. Coordination meetings held in Northern California in late 1976 and early 1977 regarding BLM studies in Northern California.
7. Regional Studies Plan Coordination Meeting held at the Pacific OCS Office in Los Angeles on May 19, 1978 with representatives from federal and state agencies. Minutes of this meeting are in Appendix B.
8. BLM Pacific OCS Office Staff recommendations.

The general issues identified for northern California are as follows:

- o Air Quality
- o Special Biological Areas and Habitats Including Threatened and Endangered Species Habitats
- o Marine Birds and Mammals
- o Commercial and Sports Fishing
- o Recreation and Aesthetics
- o Shipping and Navigation Conflicts
- o Archaeological and Cultural Resources
- o Infrastructure and Social Conflicts
- o Geologic Hazards

The concern about potential impacts from oil spills is an issue that is common to all OCS areas and is a part of each of the issues listed above. Oil spill impacts will be treated in the decisionmakers's questions section below for each major issue. As mentioned previously, this plan will be reviewed and updated annually to reflect the most recent public issues and concerns for the northern California area.

C. Management Questions Related to Major Issues and Impacts. Once the issues related to major expected impacts of OCS development for northern California have been identified as above, the next step is to list the management questions or decisionmaker's questions that will be asked at the significant decision points in the leasing process for FY 1979 and 1980. As discussed in the introduction to this chapter, the major leasing decision points for Sale No. 53 in the timeframe from 1978 up to the proposed sale date in February, 1981 are: evaluating major impacts for the environmental statement process; developing proposed lease stipulations and potential alternatives to mitigate significant adverse impacts identified in the environmental assessment process; and providing effective, timely information for the Secretary of Interior's final OCS management decisions based on the SID.

In developing a problem solving framework of analysis from which areas of environmental studies can be identified, one should recognize there are a number of ways in which to express the types of information to be collected and the relative limitations of that information. First, there are the legal-regulatory questions that can be answered in a fairly straightforward yes or no manner. For instance, will the proposed action result in emissions to the atmosphere that exceed air quality standards?

There is also the economic or commercial approach which attempts to reduce all of the information to dollars and then determine the trade-offs of various alternatives. Although this approach is relatively easy to understand since most people can relate to the monetary value of something, it has serious limitations in, for instance, the areas of ecological impact. No one has yet been able to successfully place a dollar value on copepod populations or flocks of

seabirds that might be lost as a result of spilled oil. The ecological or indirect effects questions are some of the most difficult to answer, and may only be addressable through probabilistic statements. A discussion of the probability of loss of copepods and other organisms found higher in the trophic scheme must be qualified by statements of accuracy and available data and the underlying assumptions on which a probability distribution can be based. This may be the best that can be done in assessing some forms of impacts and should be accepted as a legitimate technique.

Finally, there are resource use conflicts that depend in large part on data trends and qualitative judgements or considerations. An example of this could be in the determination of impact of oil and gas operations on flounder fisheries. One could only analyze the available information on trends in this fishery and make some qualitative judgements regarding potential impacts. For some categories of information, this may be the only feasible way to treat the data.

Of the many questions that could arise from an issue-decision pair, the primary means used in this document for focusing on what specific information should be sought and evaluated is a series of hierarchically arranged questions. The techniques used in this problem analysis should have sufficient flexibility to permit a mix of all four types of information treatment.

The hierarchy begins with the highest level of inquiry, that of the decisionmaker. These questions are oriented toward specifying direct and indirect economic losses by major multiple use conflict. Next are the mid-level questions which specify losses, primarily economic, by impact producing agents. Finally, there are a series of technical questions which are intended to be flexible enough to accommodate more specific details of the problem as dictated by decision points and region. They are also specific but flexible enough that they will identify ecologic or social losses which cannot be translated into economic losses. In such cases, this information can move up the hierarchy to aid the decisionmaker to identify potential losses in non-economic terms.

Decisionmakers would like to know the magnitude of direct and indirect economic losses which are expected to be sustained as a result of use conflicts generated by the leasing proposals, and the extent to which these losses can be minimized through mitigating measures. These factors will provide information for the estimation of the net social value of a lease sale including an assessment of the losses due to the environmental degradation. The major decisionmaker's questions with respect to multiple use conflict are:

What is the expected reduction in benefits derived from man's use of the environment due to the major multiple use conflicts and the leasing proposal?

and

Given the answer to the above question, what is the socially efficient level of investment in mitigating measures?

Economic losses due to impact producing agents are also necessary for decisions concerning the proper level and type of investment to be made in mitigating measures. The major decisionmaker's questions related to impact-producing agents are:

What economic and environmental losses are expected to be sustained as a result of the following impact producing agents?

1. Oil spills and other contaminant discharges.
2. OCS-related onshore structures
3. OCS-related offshore structures
4. Onshore and offshore air emissions
5. Onshore effluents
6. Increased vessel traffic
7. Changes in economic activity

and

Given the type and magnitude of economic and environmental losses resulting from the impact producing agents, what levels of investment in mitigating measures should be made through application of OCS Operating Orders, special lease stipulations, EPA regulations and guidelines, the Coastal Energy Impact Fund, and tract deletions?

The specific major, mid-level and technical questions related to each issue listed previously in Section B are as follows:

#### 1. Air Quality

##### Decisionmaker's Questions:

What regional social costs due to air quality degradation can be expected as a result of the leasing proposal?

and

Given the answer to the question above, what is the nature, scope, degree, and cost of investment in mitigating measures?

##### Mid-Level Questions:

1. What social costs can be expected as a result of onshore air quality degradation?
2. What social costs can be expected as a result of offshore air quality degradation from proposed OCS development and production operations?

3. What will be the impact on ambient air quality resulting from a major oil spill?
4. Given the extent to which emission standards are expected to be violated, what investment in mitigating measures should be made through OCS Operating Orders, and EPA regulations and Guidelines to meet these standards?
5. If standards are not violated and emissions are still expected to cause a significant social cost, what investment in mitigating measures should be made?

Technical Questions:

1. What are the ambient air quality conditions?
2. What are the patterns of air circulation/diffusion over the area in question?
3. What are the present state and federal air quality standards for the area? What are the proposed air quality standards and regulations for the area?
4. To what extent will the emissions from standard or accidental OCS development activities violate current and proposed emission standards?
5. If standards are not violated, will the expected increase in the level of emissions still cause significant social costs?
6. What temporary social costs can be expected to result from short-term increases in emissions caused by adverse meteorological conditions?
7. What is the expected cumulative level of emissions due to processing plants, oil transfer operations, and offshore operations?
8. What are the biological and human health hazards possible due to OCS-related air contaminants?
9. What are the probabilities of these impacts occurring in the area? Will they be short-term or long-term effects?
10. What is the probability of a major spill occurring? What are the quantities of major air quality emissions from a major oil spill? Will the emissions adversely affect air quality standards in the area?

11. What mitigating measures are available to reduce air quality impacts from OCS development?
  12. How much will it cost to implement these mitigating measures in order to meet air quality standards?
2. Special Biological Areas and Habitats Including Threatened and Endangered Species Habitats

Decisionmaker's Questions:

What is the probability that any OCS development activity will significantly impact biological populations and their habitats within or adjacent to the proposed lease area?

and

Given the answer to the question above, what investment in mitigating measures is necessary to reduce the probability of significant impacts to an acceptable level?

Mid-Level Questions:

1. What are the expected impacts on biological populations and habitats as a result of proposed OCS development activities?
2. Will endangered and threatened species or critical habitats be significantly impacted by normal or accidental OCS development activities?
3. Will OCS development be consistent with the intents and purposes of the National Environmental Policy Act, the Endangered Species Act, and the Marine Mammal Protection Act?
4. Given the potential reduction in biological populations and habitats and after consultation with U.S. Fish and Wildlife Service, what investment in mitigating measures should be made through OCS Operating Orders, special stipulations, EPA Regulations and Guidelines, and tract deletions?
5. To what extent will this investment reduce the probability of significant impact to protected species and critical biological habitats?

Technical Questions:

1. What types of biological habitats exist in northern California? Are any of these habitats special or critical? Why? Where are these habitats located?

2. What are the dominant species and biological communities in the area and what are the potential direct and indirect effects of OCS development activities on these species and communities?
3. Are there any endangered, threatened, protected or unique species or populations within or adjacent to the proposed lease area? Why are they in a protected status or considered unique? What is the status of these species?
4. Where are the special biological areas for protected or endangered species (e.g., feeding areas, breeding areas, resting areas, migration corridors) within or adjacent to the proposed lease area?
5. What are the normal or seasonal variations in populations of endangered or protected species and at what stage of their life cycles may possible impacts occur?
6. What commercially important biological species occur within or adjacent to the proposed lease area and what are the potential direct and indirect effects of OCS development on these species?
7. What is the frequency and magnitude of oil spills and other contaminant discharges which are expected to impact biological populations and habitats over the life of the field?
  - a. What is the expected size, number, and timing of acute oil spills over the life of the field?
  - b. What is the expected rate and cumulative amount of small acute spills, chronic spills, and other contaminant discharges (e.g., formation waters, drilling muds and additives)?
  - c. What are the vulnerable abiotic processes (i.e., mechanisms of transport, transformation, and transfer which interrelate biologic communities with their habitat) that sustain populations with high biologic and social values?
  - d. What are the vulnerable habitats that sustain populations with high biological and social values (e.g., marine sanctuaries, national wildlife refuges, etc.)?
  - e. What are the expected trajectories of oil spills and other contaminant discharges?
  - f. What is the expected physiochemical condition of the oil at the time it impacts a vulnerable population or critical habitat?

8. Will the impacts from OCS oil spills and other contaminant discharges interfere significantly with existing species and habitats?
    - a. What is the expected behavioral response of vulnerable species to the presence of oil?
    - b. What is the expected effect on the overall resilience and stability of vulnerable populations in terms of growth, survival, and reproduction?
    - c. Is the presence of oil expected to destroy or degrade critical habitats so as to preclude their use?
    - d. What are the expected significant cumulative effects (e.g., biomagnification of contaminants, threshold physiologic sensitivities, etc.) on existing populations and habitats from continuous exposure to low level contaminant discharges?
  9. What will be the expected alteration in biological populations or the reduction in critical habitat space due to OCS-related structures and associated noise?
    - a. What is the expected behavioral response of vulnerable species to noise pollution?
    - b. What are the expected number and location of OCS-related offshore and onshore structures?
    - c. Are OCS-related offshore and onshore structures and associated construction activities (e.g., causeways, gravel islands, pipeline burial, and dredged material disposal) expected to interfere significantly with existing populations and habitats?
  10. What mitigating measures are available to reduce the significant impacts identified?
  11. How much will these mitigating measures cost and how effective will they be?
3. Marine Birds and Mammals

Decisionmaker's Questions:

What is the probability that any OCS development activity will significantly impact marine bird and mammal populations and habitats within or adjacent to the proposed lease area?  
and



Given the answer to the question above, what investment in mitigating measures is necessary to reduce the probability of significant impact to an acceptable level?

#### Mid-Level Questions:

1. What are the potential and realized effects of OCS development activities on seabird and marine mammal populations and habitats?
2. What are the potential and realized effects of accidents such as major oil spills associated with OCS development on seabird and marine mammal populations and habitats?
3. Will OCS development be consistent with the intents and purposes of the National Environmental Policy Act, the Endangered Species Act, and the Marine Mammal Protection Act?
4. Given the potential reduction in biological populations and habitats of marine birds and mammals and after consultation with the U.S. Fish and Wildlife Service, what investment in mitigating resources should be made through OCS Operating Orders, special stipulations, EPA Regulations and Guidelines, and tract deletions?
5. To what extent will this reduce the probability of significant impact to marine bird and mammal populations and habitats?

#### Technical Questions:

1. What seabird and marine mammal species, populations and habitats are found within or adjacent to the proposed sale area?
2. What are the distributions and abundances of seabird and marine mammal populations in the area?
3. Are there any endangered, threatened or protected seabird and marine mammal species or habitats in the area?
4. What are the seasonal variations of seabird and marine mammal populations and habitat use in the area? Where are the major bird and mammal migratory pathways and how intensively are they used by season?
5. Where are special biological areas for seabirds and marine mammals (e.g., feeding areas, breeding areas, nesting areas, migratory corridors) located within or adjacent to the proposed lease area?

6. What will be the extent of human disturbance impacts from construction or other activities associated with OCS development on seabird and marine mammal populations? What is their probability of occurrence?
7. At what stage of OCS development activity will these impacts occur?
8. What significant short-term or long-term cumulative or magnifying impacts can OCS development cause for seabird and marine mammal populations in the area?
9. What are the probabilities of major oil spills occurring in the area from proposed OCS development?
10. Will predicted oil spill trajectories from the proposed lease blocks be concentrated in significant areas of seabird or marine mammal habitats or distributions?
11. What are the realistic mitigating measures that can be selected to prevent significant impacts from OCS development on seabird and marine mammal populations and habitats?
12. How much will these mitigating measures cost and how effective will they be?
13. How effective are the oil spill contingency plans in the area for protecting seabird and mammal habitats?

#### 4. Commercial and Sports Fishing

##### Decisionmaker's Questions:

What socioeconomic losses are expected to be sustained by (1) the fishing industry, (2) consumers of fish products, and (3) the regional economy as a result of the leasing proposal?

and

Given the answer to the question above, what is the socially efficient level of investment in mitigating measures?

##### Mid-Level Questions:

1. What will be the significant impacts on commercial and sport fishing in northern California from proposed OCS development?
2. Will proposed OCS development activities significantly disrupt the large bottom trawling fishing areas off northern California?

3. How will proposed OCS development activities affect the significant sports fishing areas in northern California?
4. Will normal or accidental activities from proposed OCS development significantly affect the spawning and nursing areas of important commercial or sports fish species?
5. Will accidents such as major oil spills from proposed OCS development cause major impacts on commercial and sports fishing areas?
6. What will be the expected consumer losses for fish products in northern California as a result of proposed OCS development activities?
7. Given the type and magnitude of economic losses resulting from the impact producing agents, what level of investment in mitigating measures should be made through OCS Operating Orders, special stipulations, EPA Regulations and Guidelines, and tract deletions?
8. To what extent will this reduce the risk of significant impacts to commercial and sport fishing?
9. What is the expected gain to commercial and sports fishermen as a result of offshore structures providing fish habitats?

Technical Questions:

1. What are the commercial and sports finfish and shellfish species caught in the area?
2. Where are the major commercial and sports fishing areas in northern California?
3. What type of fishing takes place in each area and what gear is used?
4. What are the annual, seasonal and historical volumes and value of commercial and sports fishing in potential leasing areas?
5. What potential physical conflicts with proposed OCS development are significant to the fishermen in the area?
  - a. What is the nationwide historical record for fishing damage from OCS development? What is the dollar value of this damage?
  - b. What is the expected alteration or reduction in fishing space due to surface and subsurface structures?

- c. What is the expected reduction in catch per unit effort for fishermen in the area as a result of these potential physical conflicts?
6. What are the frequency and level of acute and chronic discharges expected to impact commercial fisheries over the life of the field?
  - a. What is the expected size, number, and timing of acute oil spills over the life of the field?
  - b. What is the expected cumulative amount and timing of chronic discharges over the life of the field?
  - c. What are the expected trajectories of acute and chronic discharges?
  - d. What is the expected physiochemical condition of an acute oil spill at the time it impacts a commercial fishery?
  - e. What natural conditions can be expected to inhibit or promote resumption of fishing activity given an initial restriction in fishing use? What is the expected period of closure?
  - f. What is the expected behavior response of commercial species to the presence of oil?
  - g. What are the expected rates of recruitment and reproduction (including lethal and non-lethal effects in various life stages) of commercial species following an acute oil spill?
  - h. What are the expected cumulative effects on commercial species from continuous exposure to low level containment discharges?
  - i. To what extent is tainting of commercial fish stocks or other quality changes expected to occur?
7. Given the answers to the questions above, what is the expected reduction in the catch per unit effort of fishermen and industry revenues resulting from; (a) restriction of fishery use, (b) mortality of commercial species, (c) displacement, (d) impact on year classes of fish, and (e) tainting (whether perceived or real)?
8. What are the effective mitigating measures that can be selected to prevent significant impacts from OCS development to the commercial and sports fishing industries?

9. How much will these mitigating measures cost and how effective will they be?
10. What is the nationwide historical record of catch per unit effort and the economic value for commercial and sports fishing around existing offshore facilities? After an oil spill?
  - a. How will this data apply to commercial and sports fishing in northern California?
  - b. What will be the projected economic value on a yearly basis for commercial and sports fishing catches around proposed offshore development facilities in northern California for various projected development scenarios?

## 5. Recreation and Aesthetics

### Decisionmaker's Questions:

What losses can be expected to be sustained by (1) the recreation industry, (2) recreationists, and (3) the regional economy as a result of the leasing proposal?

and

Given the answer to the question above, what is the socially efficient level of investment in mitigating measures?

### Mid-Level Questions:

1. What losses will be sustained by the recreation industry as a result of proposed OCS development activities?
2. Given the expected potential reduction in the supply of recreational opportunities or quality changes, what are the expected social costs for recreationists?
3. Given the potential losses expected to be sustained by the recreation industry and recreationists, what are the expected changes in regional income, employment, and population?
4. Given the type and magnitude of losses resulting from the impact producing agents, what level of investment in mitigating measures should be made through OCS Operating Orders, special stipulations, and tract deletions?
5. To what extent will this investment reduce the risk of significant impacts on recreation and aesthetics in northern California?

## Technical Questions:

1. What are the major recreational and aesthetic opportunities and resources available in northern California?
2. Where are these opportunities and resources located?
3. How many people per year use these opportunities and resources and what is the economic value of these uses?
4. What are the frequency and magnitude of acute and chronic oil spills that are expected to impact high use recreational areas over the life of the field?
  - a. What are the expected size, number, and timing of acute oil spills over the life of the field?
  - b. What are the expected cumulative amount and timing of chronic oil spills over the life of the field?
  - c. What are the expected seasonal trajectories of acute and chronic oil spills?
  - d. What is the expected physiochemical condition of an acute oil spill at the time it impacts a recreational area?
  - e. What natural conditions can be expected to inhibit or promote resumption of recreational activities given an initial restriction in these activities? What is the expected period of closure?
  - f. What is the expected reduction in activity as a result of the degraded quality of the activity?
  - g. Will the expected reduction in the supply or quality of beaches and fishing grounds result in the use of other recreation facilities?
  - h. To what extent will revenues expected from expenditures on other recreational activities offset the revenues lost in the impacted activities?
5. What are the number and type of onshore structures expected to be constructed near recreational areas?
  - a. How will these proposed onshore structures affect nearby recreational activities?
  - b. Will these be short-term or long-term effects and what will be their significance?

6. Given the answers to the questions above, what is the expected reduction in industry revenues resulting from a restriction of recreation use or the degraded quality of recreational activity?
7. What mitigating measures can be selected to prevent significant impacts from OCS development activities on the recreation and aesthetic resources and opportunities in northern California?
8. How much will these mitigating measures cost and how effective will they be?

6. Shipping and Navigation Conflicts

Decisionmaker's Questions:

What losses are expected to be sustained by the shipping industry and marine traffic as a result of the leasing proposal?

and

Given the answer to the question above, what is the socially efficient level of investment in mitigating measures?

Mid-Level Questions:

1. What losses can be expected as a result of collisions between ships and offshore structures?
2. What losses can be expected as a result of acute oil spills?
3. What losses can be expected as a result of OCS-related vessel traffic?
4. Given the type and magnitude of losses expected to result from the impact producing agents, what level of investment in mitigating measures should be made through OCS Operating Orders, special stipulations, EPA Regulations and Guidelines, and tract deletions?
5. To what extent will this investment reduce the risk of significant impacts on shipping in northern California?

Technical Questions:

1. What are the expected number and proposed locations of fixed surface structures?
2. What is the intensity and historical pattern of shipping activity in the area?

3. Where are the locations of shipping lanes (if any)?
4. What are the historical frequency and magnitude of vessel damage related to offshore oil and gas development in other OCS areas?
5. What are the expected number, type, and frequency of OCS-related vessels?
6. Given the answers to the questions above, what is the expected damage to shipping and marine traffic as a result of offshore structures?
7. What mitigating measures can be selected to prevent significant impacts from OCS development activities to shipping and marine traffic in northern California?
8. How much will these mitigating measures cost and how effective will they be?

7. Archaeological and Cultural Resources

Decisionmaker's Questions:

What social losses due to damage of archaeological and historic resources can be expected as a result of the leasing proposal?  
and

Given the answer to the question above, what is the socially efficient level of investment in mitigating measures?

Mid-Level Questions:

1. What social losses are expected as a result of archaeological and historic resources being damaged or destroyed by oil spills?
2. What social losses are expected as a result of archaeological and historic resources being damaged or destroyed by the placement of OCS structures?
3. Given the expected potential damage to archaeological and historic resources, what level of investment in mitigating measures should be made through OCS Operating Orders, special stipulations, and tract deletions?
4. To what extent will this investment reduce the risk of significant impacts on archaeological and cultural resources in northern California?



## Technical Questions:

1. What are the significant offshore and coastal archaeological and cultural resources in northern California?
2. Where are the resources located and where are the areas of highest potential for the discovery of archaeological and historic resources which may be impacted by OCS development?
3. What archaeological and historic resources with historic value are protected under provisions of the Antiquities Act?
4. What are the expected frequency and level of acute spills and significant discharges over the life of the field?
  - a. What are the expected size, number, and timing of these discharges over the life of the field?
  - b. What are the expected trajectories of such discharges?
5. What are the expected number and location of onshore and offshore OCS structures?
6. What is the expected damage to archaeological and cultural resources protected under provisions of the Antiquities Act?
7. What mitigating measures can be selected to prevent significant impacts from OCS development activities to archaeological and cultural resources in northern California?
8. How much will these mitigating measures cost and how effective will they be?

8. Infrastructure and Social Conflicts

## Decisionmaker's Questions:

What regional costs can be expected due to infrastructure and local stresses generated by the leasing proposal?

and

Given the answer to the question above, what is the socially efficient level of investment in mitigating measures?

## Mid-Level Questions:

1. What regional costs are expected as a result of infrastructure stresses induced by changes in coastal zone economic activity?
2. What social costs are expected as a result of changes in coastal zone economic activity?
3. To what extent are non-socially disruptive changes in cultural patterns and values deemed a significant loss?

4. Given the type and magnitude of economic losses resulting from the impact producing agents, what should be made through OCS Operating Order and the Coastal Energy Impact Program?
5. What is the expected reduction in socioeconomic losses as a result of this investment?

Technical Questions:

1. What are the expected demographic changes with the leasing proposal?
  2. What is the expected increase in demand for social services such as schools, health care, housing, law enforcement, fire protection, water supply, energy supply, solid waste disposal, and sewage?
  3. To what extent is short-term inflationary pressure expected to result from competition for harbor space, marine services, land, and capital?
  4. What are the expected long-term changes in the economic base of the area?
  5. Given the potential expected long-term economic changes, what is the expected effect on social stability (community values, social rank and role, standard of living)?
  6. What mitigating measures can be selected to prevent significant impacts from OCS development activities to the infrastructure and socioeconomic climate in the northern California coastal region?
  7. How much will these mitigating measures cost and how effective will they be?
9. Geologic Hazards

Decisionmaker's Questions:

What will be the significant environmental impacts from geologic hazards in offshore northern California related to oil and gas development?

and

Given the answer to the question above, what investment in mitigating measures is necessary to reduce the impacts to an acceptable level?

## Mid-Level Questions:

1. What geological conditions in offshore northern California are potentially hazardous to OCS development?
2. What OCS activities in northern California will increase the risk of geologic hazards?
3. What investment in mitigating measures should be made through OCS operating orders, special stipulations, and tract deletions?
4. To what extent will this reduce the risk of geologic hazards impacting OCS development activities?

## Technical Questions:

1. What types of geologic hazards are encountered in this area and where are they located?
2. What is the magnitude of suspected geologic hazardous phenomena?
3. Where are the locations of known earthquake epicenters and their magnitude?
4. Which areas of sediment accumulation appear to be unstable based on sediment thickness, slope and regional slumping?
5. Where are the recent (Holocene) faults and what are their trends and movements?
6. Where are the locations of shallow gas pockets and gas seeps that could be hazardous to drilling operations?
7. Which OCS-related structures and activities are most vulnerable to these hazards?
8. What is the probability of a geologic hazard occurring that is insurmountable by present technological capability?
9. At what stage of OCS activity will these impacts be critical?
10. What is the probability of a geological hazard causing a major oil spill?
11. What mitigating measures are available or technologically feasible to reduce the significant impacts identified?
12. How much will these mitigating measures cost and how effective will they be?

CHAPTER IV. SCIENTIFIC ASSESSMENT

Up to this point this plan has identified the major impacts, issues and management questions related to Federal OCS oil and gas leasing and development activities for northern California for proposed OCS Sale No. 53. The first part of this chapter will give an overview of significant northern California environmental information and on-going projects that relate to the major issues identified in Chapter III. The Summary of Knowledge compiled under BLM contract by Winzler and Kelley, described in Chapter II, gives an extensive summary of past and on-going research projects for the northern California OCS and coastal zone.

The second part of this chapter is an appeal to outside scientists and reviewers to evaluate old and new approaches for answering the questions developed in Chapter III. BLM solicits constructive criticism of the study types developed in Chapter V to answer these questions. This plan must identify studies that can feasibly provide information to answer the management questions in time for the scheduled leasing decisions described in Chapter II. Because of funding and time constraints, BLM will have to answer many of the questions with the best available information. Some of the questions might not be suitable for BLM studies in FY 1979 and 80 since they will not fit the time frame for potential leasing and development decisions for OCS Sale No. 53.

A. A Review of Environmental Information Related to Major Northern California Issues for Federal OCS Oil and Gas Development

1. Air Quality. Chapter III-6 of the Winzler and Kelley report summarizes the available information on air quality and pollution sources for northern California. Most of the available data has been assembled by the State Air Resources Board and the local Air Pollution Control Districts. Some modeling of air quality emissions and trajectories has been performed in the San Francisco area. Generally, the air quality is very good along the northern California coast with the exception of the major populated areas around San Francisco, Eureka, and Monterey.

2. Special Biological Areas and Habitats Including Threatened and Endangered Species Habitats. This issue covers a broad category of concern about the marine and coastal environment spanning several scientific disciplines. There has been a considerable amount of work done in the past few years by the California Coastal Commission and others to identify special biological habitats along the California coast. The U.S. Fish and Wildlife Service (FWS) and the California Department of Fish and Game (CDF&G) have intensified information gathering of protected species and habitats in the coastal area. However, the information concerning special biological areas and habitats offshore on the continental shelf, especially in Federal waters beyond the three-mile limit, is scanty and almost unknown.

The consensus for the BLM-sponsored San Francisco Open Meeting on recommendations for baseline research in central and northern California was that the central and northern California OCS is a very poorly studied region of the U.S. Continental Shelf. Furthermore, offshore data are meager for all of the marine disciplines from north of San Francisco to the Oregon Border. Offshore data collection in the past has been limited by funds and a lack of large oceanographic research vessels in central and northern California. Consequently, most of the marine investigations, with the exception of the California Cooperative Fisheries Investigation (CalCOFI) program, have been nearshore, intertidal or estuarine studies. Most marine investigations have centered around coastal marine labs and well-studied areas such as Monterey Bay, San Francisco Bay and Humboldt Bay (Figure 6).

Some fates and effects studies and other predictive work on impacts related to OCS development on biological species and habitats have been conducted, but most of the information concerns acute effects. There have been no studies relating to the economic and social costs of these impacts or studies of the potential mitigating measures that could be applied to reduce significant impacts of OCS development activities on special biological habitats or protected species.

a. Identification of Special Biological Areas and Habitats. Much of the northern California coast has a low population density except around major cities and, consequently, the coastal environment is in a relatively pristine condition. The California Coastal Plan has identified several critical areas along the coast of recreational, scenic and biological value. The California State Lands Commission has also listed several coastal resources in the "Inventory of Unconveyed State School Lands and Tide and Submerged Lands Possessing Significant Environmental Values" published in December, 1975. The State of California Water Resources Control Board has designated several Areas of Special Biological Significance (ASBS) along the coast to preserve the water quality and unique biological resources in these areas. The ASBS's are listed in Table 3 and displayed in Figure 7. The California Department of Fish and Game manages several refuges and reserves along the coast. These are shown in Figure 8. In addition, California Department of Parks and Recreation administers several state parks, beaches and reserves along the coast.

Federally protected coastal habitats in northern California include the Farallon Island Federal Wildlife Refuge, the Humboldt Bay Wildlife Refuge, San Pablo Bay Wildlife Refuge and South San Francisco Bay Wildlife Refuge managed by the Fish and Wildlife Service; King's Range National Conservation area managed by the Bureau of Land Management; Redwoods National Park, Pt. Reyes National Seashore and the Golden Gate National Recreation Area from Golden Gate in San Francisco to Stinson Beach managed by the National Park Service.

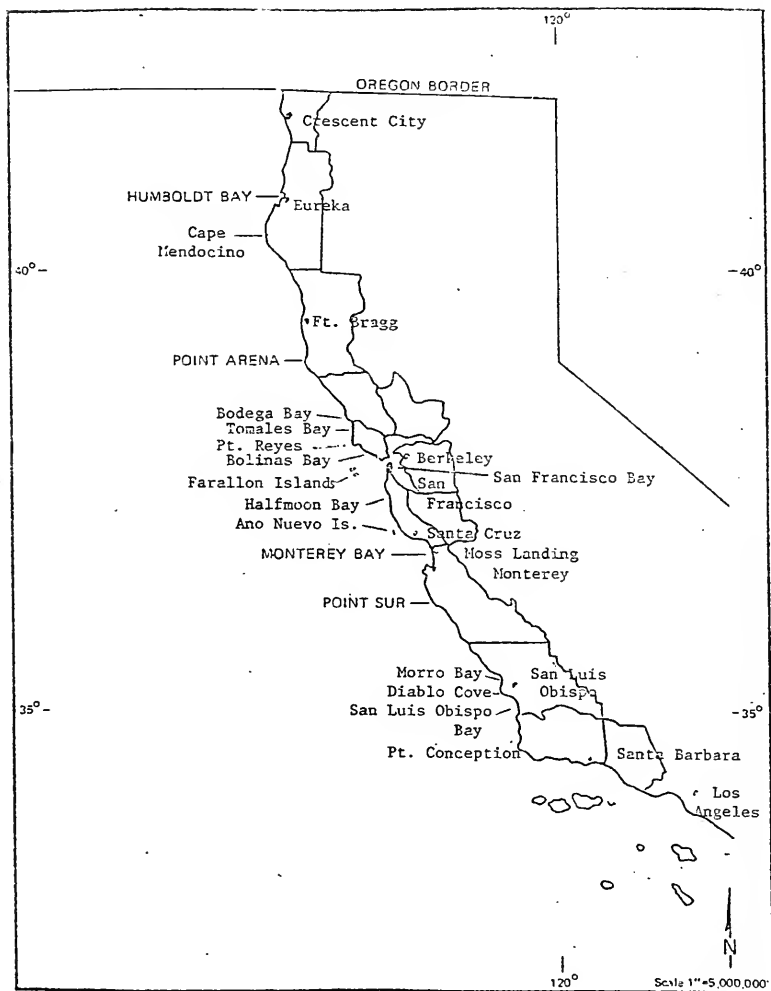


Figure 6. Coastal Map of Central and Northern California.

TABLE 3

STATE WATER RESOURCES CONTROL BOARD  
AREAS OF SPECIAL BIOLOGICAL SIGNIFICANCE

Designated March 21, 1974, April 18, 1974, and June 19, 1975

1. *Pygmy Forest Ecological Staircase*
2. *Del Mar Landing Ecological Reserve*
3. *Gerstle Cove*
4. *Bodega Marine Life Refuge*
5. *Kelp Beds at Saunders Reef*
6. *Kelp Beds at Trinidad Head*
7. *Kings Range National Conservation Area*
8. *Redwoods National Park*
9. *James V. Fitzgerald Marine Reserve*
10. *Farallon Island*
11. *Duxbury Reef Reserve and Extension*
12. *Point Reyes Headland Reserve and Extension*
13. *Double Point*
14. *Bird Rock*
15. *Ano Nuevo Point and Island*
16. *Point Lobos Ecological Reserve*
17. *San Miguel, Santa Rosa, and Santa Cruz Islands*
18. *Julia Pfeiffer Burns Underwater Park*
19. *Pacific Grove Marine Gardens Fish Refuge and Hopkins Marine Life Refuge*
20. *Ocean Area Surrounding the Mouth of Salmon Creek*
21. *San Nicolas Island and Begg Rock*
22. *Santa Barbara Island, Santa Barbara County and Anacapa Island*
23. *San Clemente Island*
24. *Mugu Lagoon to Latigo Point*
25. *Santa Catalina Island — Subarea One, Isthmus Cove to Catalina Head*
26. *Santa Catalina Island — Subarea Two, North End of Little Harbor to Ben Weston Point*
27. *Santa Catalina Island — Subarea Three, Farnsworth Bank Ecological Reserve*
28. *Santa Catalina Island — Subarea Four, Binnacle Rock to Jewfish Point*
29. *San Diego-La Jolla Ecological Reserve*
30. *Heisler Park Ecological Reserve*
31. *San Diego Marine Life Refuge*
32. *Newport Beach Marine Life Refuge*
33. *Irvine Coast Marine Life Refuge*
34. *Carmel Bay*

FIGURE 7

# Areas of Special Biological Significance



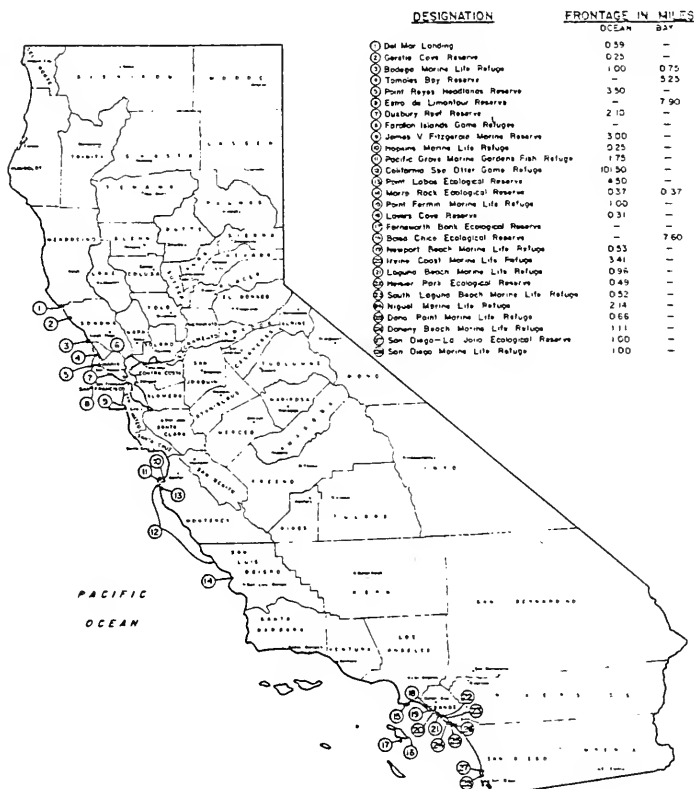
JULY 1976

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD



FIGURE 8

## MARINE LIFE REFUGES &amp; RESERVES



The Farallon Islands are the largest seabird rookeries in the United States outside of Hawaii and Alaska, with over 300 species of birds nesting on the islands. The Farallons are also a critical marine mammal rookery area for the stellar sea lion, the northern elephant seal and the California sea lion.

Some other special coastal environments besides those included in the government-protected areas listed above are the seabird nesting areas on Castle Rock near Crescent City and Morro Rock in Morro Bay identified as endangered species nesting habitats; the eel grass/Black Brandt habitat in Elkhorn Slough in Monterey Bay identified at a meeting at Moss Landing Marine Laboratory; and the entire Elkhorn Slough ecosystem in Monterey Bay, identified at the same meeting at Moss Landing and by the State of California Coastal Wetland Series. In addition, there are several offshore rocks and small islands along the coast listed as important seabird nesting sites.

Unique offshore environments are not as well known but some have been identified by the San Francisco Open Meeting and the California Department of Fish and Game. These include the heavily used trawl fishery area off Monterey Bay to Pt. Sur and off Eureka out to 600 fathoms; the Cordell Banks southwest of Pt. Reyes as an important partyboat fishing area; Pt. Sur Reef out to 100 fathoms as an important partyboat and commercial fishing area; the Dungeness Crab fisheries range in the Gulf of the Farallons and San Francisco Bay; and Monterey Submarine Canyon.

Aquaculture research and farming is increasing along the central and northern California coast. These areas are special environments in the sense that they are very vulnerable to water pollution. Humboldt State University has aquaculture research programs for salmon and trout. Bodega Bay Marine Laboratory is investigating the rearing of the American lobster and other crustaceans for commercial production on the West Coast. Tomales Bay and Drake's Estero on the Pt. Reyes Peninsula are sites of active oyster raft culture. Morro Bay in San Luis Obispo County supports oyster farming. In the Monterey area there are five licensed mariculture companies experimenting with potential shellfish production for abalone, oysters and clams. The California Department of Fish and Game marine culture laboratory south of Monterey Bay is studying life stages of abalone, lobster, crabs and kelp for potential commercial production.

1) Intertidal Habitats. Few quantitative intertidal sampling studies have been conducted in northern California. Generally, most studies have centered around coastal marine laboratories. Between these localized areas there are wide expanses of the coast that are inaccessible and poorly sampled. Extensive classic intertidal studies have been performed over many years at Stanford's Hopkins Marine Station in Pacific Grove, Monterey Bay. Dr. Gordon Chan of the Bolinas Marine

Lab, College of Marin, has a data base for intertidal communities at Duxbury Reef outside of Bolinas Bay extending back to 1958. These long-range investigations were continued after the 1971 San Francisco Bay Oil Spill.

The Farallon Research Group is studying intertidal invertebrates on S.E. Farallon Island to document long range baseline data for two mussel bed communities and two sea cave habitats. The research is being coordinated by the Oceanic Society of San Francisco which provides transportation for the researchers to and from the island out of its pool of volunteer boatowners. This long term research program plans to determine heavy metal and pesticide tissue levels of selected intertidal invertebrates and to assess the reproductive condition over time for the same species being analyzed for pollutant concentrations.

California Department of Fish and Game, under contract to Pacific Gas and Electric Company, quantitatively sampled intertidal macroinvertebrates and algae at stations around Pt. Arena and Diablo Cove below Morro Bay for proposed power plant sites. Stratified random sampling with 0.24 m<sup>2</sup> quadrats was used for all collections. Other localized quantitative intertidal investigations have been conducted in San Francisco Bay and Elkhorn Slough.

Coastal wetlands and estuaries are more abundant in northern California than southern California. The U.S. Fish and Wildlife Service (FWS) and the California Department of Fish and Game (CDF&G) have inventoried the wetland areas. CDF&G has a series of publications for important wetlands along the coast summarizing available information and current use. FWS has contracted for an analysis of onshore, estuarine and marine effects of coastal and OCS oil and gas development on fish and wildlife resources and coastal ecosystems from Cape Mendocino, California to Cape Flattery, Washington. This will be an intensive data analysis from 200 m below sea level to the coastal mountain range. The FWS conducts an annual January wetlands census along the California Coast to provide bird species distribution and abundance data along the Pacific flyway. Major studies by Moss Landing Marine Laboratory (MLML) and the Pacific Gas and Electric Company (PG&E) have concentrated on the effects of the PG&E power plant on the large Elkhorn Slough wetland habitat in Monterey Bay.

2) Benthic Habitats. No quantitative data are available for offshore northern California except for localized repetitive studies within two to three miles of shore and within the major bays. Monterey Bay, San Francisco Bay, Humboldt Bay and an area up to five miles off Humboldt Bay have the most detailed benthic information for northern California.

Moss Landing Marine Laboratory has a five year benthic data base for Monterey Bay in water depths of 10-25 meters (30-80 feet). Significant on-going coastal projects include the large U.S. Geological Survey investigation in San Francisco Bay which includes benthic sampling; continuing benthic surveys conducted under contract by Lockheed at Diablo Cove for the Pacific Gas and Electric nuclear power plant; and localized pre-site and monitoring studies around wastewater outfalls as required by the State Water Resources Control Board. California Department of Fish and Game (CDF&G) has three years of aerial survey data for kelp beds from San Luis Obispo to Santa Cruz. The surveys were flown quarterly through most of the area with a total area survey each year in August or September.

There are several localized nearshore benthic investigations being conducted near coastal marine labs and power plants located along the coast. DeMartini and Thompson at Humboldt State University are inventorying shallow subtidal and intertidal habitats in Trinidad Harbor and off Redwood National Park in northern California. They are collecting descriptive biological information, bathymetry data and sediment distribution patterns. The Pacific Marine Station at Dillon Beach regularly conducts benthic and water column surveys in Tomales Bay. In addition, the Pacific Marine Station has collected several years of benthic grab samples out to the edge of the shelf off Tomales Bay. Most of these data have not been analyzed. Pearse at the University of Santa Cruz has been studying the kelp beds off Santa Cruz and Pacific Grove by SCUBA, and California Department of Fish and Game is investigating the sea otter/abalone/kelp bed ecology in central California and the effects of kelp bed harvesting.

3) Pelagic Habitats. The only major quantitative pelagic sampling effort offshore central and northern California are the California Cooperative Fisheries Investigations (CalCOFI) sponsored by the State of California under the direction of the Marine Research Committee. Participants are California Department of Fish and Game, Scripps Institution of Oceanography, Hopkins Marine Station, California Academy of Sciences, Moss Landing Marine Laboratories and the Southwest Fisheries Center of the National Marine Fisheries Service.

The CalCOFI program has collected repetitive samples of zooplankton and larval fishes in the upper 140 m of the California Current since 1949 over the station grid pictured in Figure 9. Every three years the sampling effort covers most of the CalCOFI grid area with cruises in the intervening years concentrating on more intensive sampling projects usually in southern waters. However, north of San Francisco Bay the CalCOFI data base is inadequate according to the recommendations of the San Francisco Open Meeting. Although several atlases showing zooplankton and larval fish distribution and biomass have been prepared, much of the collected data is awaiting sorting and analysis.

Moss Landing Marine Laboratory has conducted the CalCOFI plankton and hydrographic collections in Monterey Bay since 1971. Since 1974 the Coastal Marine Laboratory at the University of California at Santa Cruz has been sampling phytoplankton biomass and productivity during biweekly cruises in the Bay. As part of an on-going Sea Grant Project, Moss Landing Marine Laboratory and California Department of Fish and Game have been studying the population, harvest and predators of pelagic squid in central California. CDF&G's Dungeness Crab Project has been sampling pelagic larvae and nursery areas in San Francisco Bay and within 30-50 km (20-30 miles) off the entrance to San Francisco Bay.

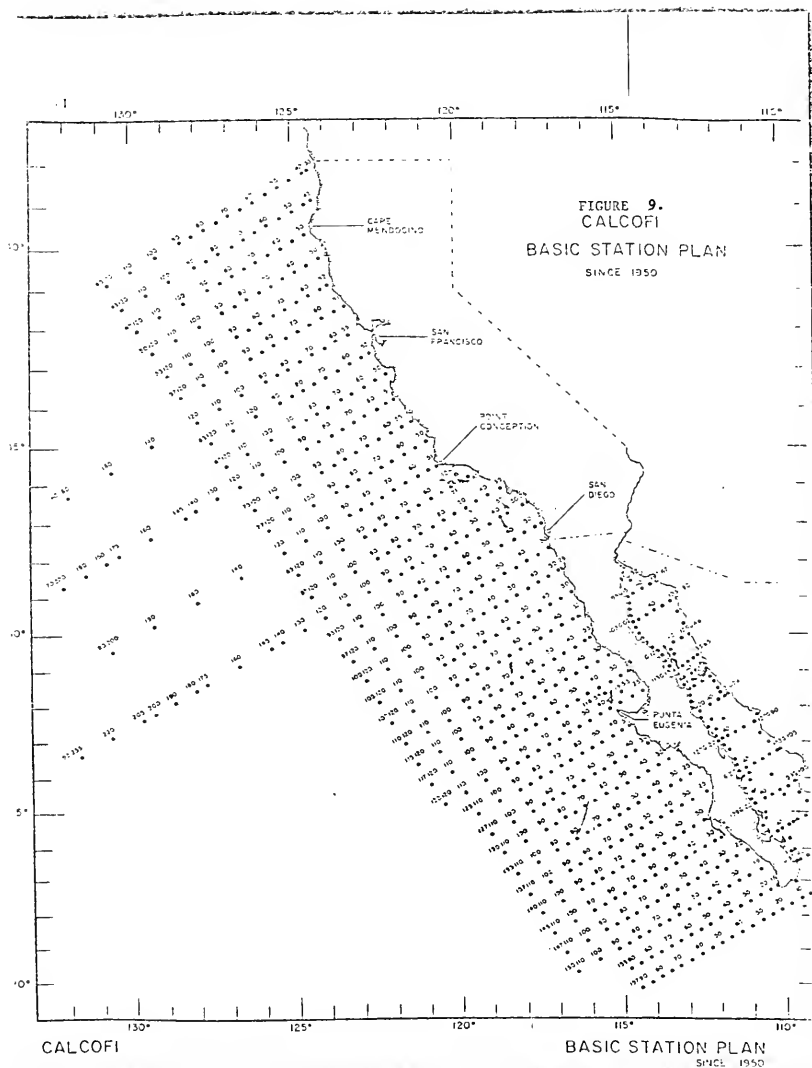
b. Fates and Effects Information

1) Toxic Effects of Oil. There is an abundance of information available on short-term, acute toxicity of oil and trace metals using static systems for a number of species. However, there have been very few studies on chronic, low level effects of these toxicants on marine organisms in open circuit or continuous flow laboratory systems.

In the northern California area, Struhsaker of the Tiburon Laboratory of the National Marine Fisheries Service has studied the effects of monocyclic aromatics (benzene, toluene and xylene) on marine fish for the past three years. Current investigations are focusing on the transport, retention and effects of the water-soluble fraction of crude oil in experimental food chains. Under contract to BLM, the studies will concentrate on the effects of Cook Inlet crude oil on a phytoplankton, clam and starry flounder food chain. The study will also assess chronic effects such as uptake rates, physiological and behavioral effects and the tolerance levels of each species exposed to a continuous, flow-through system.

DiSalvo and others at the Naval Biosciences Lab in Berkley have been studying the effects of chronically spilled oil on marine food chains in San Francisco Bay. The Army Corps of Engineers Waterways Experiment Station has investigated the uptake of hydrocarbon residues from dredged materials by marine and freshwater animals in the Bay area. At the Lawrence Livermore Laboratory at the University of California at Berkeley, Harrison and Bishop have conducted lab studies on the effects of radionuclides, trace metals and power plant operation effluents on marine organisms from Humboldt Bay, Morro Bay and the Diablo Canyon power plant. They analyzed oysters, clams and crabs from Humboldt Bay and abalone, mussels, giant kelp and fish from Morro Bay and Diablo Canyon.

A few region-specific field studies have been performed on the effects of crude oil following the 1971 San Francisco Bay spill. Chan at the College of Marin has investigated the effects of the San Francisco spill on the invertebrate populations at Duxbury Reef where he had a baseline data series extending back to 1958. Hand and others of the Bodega Bay Marine Lab assessed the repopulation of animals and plants in the



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intertidal zone after the same spill. They conducted a bi-monthly survey for twelve months to give estimates of repopulation and looked at secondary impacts by comparing the sex organs and behavior of four intertidal organisms.

2) Pollution Trajectory Information. For offshore predictive trajectory studies, the available information provides only a very general description of the wind and current regime. Current data have been collected mostly from hydrographic casts and drift card studies. There are very few direct current meter or drogue measurements for the area. For meteorological data, the largest data gap in coastal climatological information is the lack of permanent weather stations offshore. Nearly all offshore climatological information is from ship observations. In many areas, the limited number of ship observations makes the representativeness of the data suspect. Also, ships tend to avoid severe weather occurrences, possibly biasing the information towards good weather conditions. A synthesis of historical physical oceanographic and surface meteorological data is not available for the northern California OCS.

Remote sensing work supported by the Office of Naval Research, the U.S. Army Corps of Engineers, the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration and the U.S. Coast Guard has indicated distinct surface current patterns in the California current. Bernstein, Breaker and Whirtner have used data from the NOAA satellite to correlate with CalCOFI data to examine the formation of an eddy in the California Current. Other than this investigation, there is little information available on the scale, life history, and depth structure of eddies in the California Current system.

Remote sensing data sources for northern California are: 1) Army Corps of Engineers, San Francisco Office which has extensive files of low and high altitude black and white and high altitude (U-2) color imagery; 2) USGS EROS Program in Menlo Park which has image catalogs of all LANDSAT, U-2 (NASA), Gemini and Skylab photos; 3) Office of National Environmental Satellite Service in Redwood City has infrared imagery from the NOAA-5 satellite; and 4) The U.S. Coast Guard conducts monthly aerial sea surface temperature surveys from Eureka to San Diego from 40 to 80 miles offshore.

c. State of California Marine Monitoring Programs for Special Biological Areas and Coastal Habitats. In addition to participation in programs already discussed, the State of California, through the State Water Resources Control Board, is implementing a marine monitoring program for Areas of Special Biological Significance (ASBS's) along the coast. California Department of Fish and Game, under contract to the State Water Resources Control Board, conducted a one-year field sampling program during 1975-76. Samples taken in the initial effort included dissolved oxygen and pH in the water column, sediment samples and tissue analyses of mussels for pesticides, trace metals and PCBs.



Following this initial effort, the State Water Resources Control Board funded reconnaissance surveys for ten ASBSs in northern California. The ten areas are: Trinidad Head Kelp Beds, Kings Range National Conservation Area, Gerstle Cove, Bodega Marine Life Refuge, Duxbury Reef Reserve and Extension, Farallon Islands, James V. Fitzgerald Marine Reserve, Point Lobos Ecological Reserve, Pacific Grove Refuge and Hopkin's Marine Life Refuge, and Carmel Bay (See Table 3 and Figure 7). The surveys described the geology, biology, and water quality conditions in the intertidal and shallow subtidal habitats. Pygmy Forest ASBS was described in a brief summary report by California Department of Fish and Game based on available information. Four additional ASBSs will be surveyed in northern California during this next year: Julia Pfeiffer Burns Underwater Park, Pt. Reyes, Sanders Reef Kelp Beds, and Redwoods National Park.

The State of California's Mussel Watch program sampled mussels at 31 sites along the entire California coastline during the past year. Mussel tissues were analyzed for trace metals and trace organics from seasonal samples taken twice during the year. Mussel transplant activity and tissue analysis also were conducted in Humboldt Bay, Tomales Bay, San Francisco Bay, Elkhorn Slough, and Morro Bay. The Mussel Watch program will continue into this next year.

As part of the Environmental Protection Agency requirements for ocean wastewater outfalls, the State Water Resources Control Board has developed specifications for wastewater outfall studies. The predesign phase includes a literature review of the area, biological reconnaissance and six months of current measurements and geophysical investigations. The predischage phase provides additional data for outfall design and baseline information for further impact assessment. This one year field study and literature update encompasses:

- i. Geophysical studies - seismic analyses, sediment characteristics, and sediment movement
- ii. Current measurements - current meters (at least six months continuous metering), drogue studies, drift card studies, dispersion studies and density profiling
- iii. Fish and macroinvertebrate collection
- iv. Benthic infauna studies
- v. Others including dissolved oxygen, temperature, salinity and bacteriological measurements.

The area covered by field studies is generally 2-3 nautical miles (nm) either side of the outfall centerline and up to 2 nm offshore. These studies will take place or have been completed in various phases at the wastewater outfalls of Humboldt Bay, Watsonville, South Monterey Bay, San Francisco Bay, Morro Bay, South San Luis Obispo Bay, Santa Barbara and San Mateo.

3. Marine Birds and Mammals. Bi-weekly observations of seabirds along transects between San Francisco and the Farallon Islands have been conducted for several years by the Pt. Reyes Bird Observatory. However, most of the data are waiting analysis. Pt. Reyes Bird Observatory has also been surveying 35 beaches north of Pt. Conception for beached birds for several years. The data base is weak in Humboldt and Del Norte counties. These data are currently being computerized. Reynolds and Osborne surveyed coastal bird populations from the California - Oregon border to Marin County during 1969-70. The same survey also included minor rookeries and roosting sites along the whole California coast excluding coastal headlands. Estuarine, wetland and coastal bird surveys have been conducted by the California Department of Fish and Game and the U.S. Fish and Wildlife Service, but the data are fragmented. There is no comprehensive, systematic data base for the bird populations on the offshore rocks along the coast.

Data for marine mammals in northern California include the California Department of Fish and Game annual sea otter census (terminated in 1976) from Santa Cruz to Avila Beach in San Luis Obispo Bay; U.S. Fish and Wildlife sea otter data at Piedras Blancas north of Morro Bay; elephant seal censuses at Ano Nuevo Island by the University of California at Santa Cruz; several years of beached animal data collected from central California by Morejohn of Moss Landing Marine Laboratory and from the Santa Barbara Channel area by Woodhouse of the Santa Barbara Natural History Museum; observations on marine mammals of the Farallon Island Research Group; and pinniped distribution and abundance data along the whole coast collected by Dr. Mate of Oregon State University during 1974-75. In addition, California Department of Fish and Game has been periodically censusing pinnipeds along the whole California coast since 1928.

Other wildlife studies concerning marine mammals and seabirds include marine mammal predation studies being conducted by Moss Landing Marine Laboratory from Half Moon Bay to Big Sur, seabird diet studies in Monterey Bay by Morejohn and studies of the Aleutian Canada Goose at Castle Rock near Crescent City by Springer of the Fish and Wildlife Service.

The Pt. Reyes Bird Observatory is continuing its studies of the bird populations on the Farallon Islands where over 300 species of birds have been recorded. The Farallons host some of the largest seabird rookeries in the United States outside of Alaska and Hawaii and probably more than half of California's marine birds nest on the Farallons.

There is little information available on the effects of oil and other impact producing agents related to OCS oil and gas development on marine mammals and birds for northern California. Small reported on the effect of the San Francisco Bay oil spill on waterfowl. They suggested a minimum mortality of 20,000 birds with heaviest losses incurred by Western grebes, Surf and White-winged scoters and Common murre.

Griner and Herdman studied the toxic and physical effects of Santa Barbara crude oil upon waterfowl. They obtained 32 waterfowl which were involved in the 1969 Santa Barbara spill, including Western grebes, Surf scoters, Common loons, Common murrelets and Eared grebes. Pathology studies of these birds showed that death was caused by malnutrition due to reduced or total loss of food intake (caused by the stress of oiling and cleaning) compounded by heavy parasitism, and by respiratory infections acquired during captivity at the treatment center. It appeared that the incidence of fungal and infectious diseases increased with time in captivity. There was no evidence of toxic changes in any of the tissues of the birds from Santa Barbara.

Grau and Roudyboush at the University of California at Davis have observed the effects of ingested oil on bird egg production. Grau and others have demonstrated that a single dose of 200 mg of Bunker C oil ingested by Japanese Quail reduced egg production and interfered with embryonic development resulting in decreased hatchability. In a 1978 issue of Science magazine, Miller and others reported that herring gull chicks given low (0.2 ml) doses of crude oil had multiple sublethal effects that could reduce long-term survival chances.

The U.S. Fish and Wildlife Service (FWS) conducted an oil spill response workshop in 1977 to improve its capability and effectiveness in responding to oil spills. The workshop was co-sponsored by the Office of Migratory Bird Management and the Office of Biological Services. The Office of Migratory Bird Management is leading the effort to develop a FWS oil spill contingency plan for wildlife resources that will be a part of the National Oil Spill Contingency Plan. FWS researchers at the Pautaxant Research Center in Maryland are investigating the effects of oil on several bird species.

Simpson, LeBoeuf and Brownell studied the effects of oil on elephant seal and sea lion pups following the 1969 Santa Barbara Oil Spill. Tag returns for elephant seal pups showed that oily pups survived as well as clean pups. For sea lion tag returns, more dead sea lion pups were oil-fouled than living pups, although no cause-and-effect relationships could be post-dated from the scant data.

American and Russian observations and experiments demonstrate that the sea otter is highly vulnerable to oil contamination. Oil can seriously decrease the insulating properties of the sea otter's coat and lead to death by hypothermia. Present rescue and cleaning procedures for oiled sea otters are difficult and costly, with a low success rate. Experiments conducted in Alaska show that surface oil can be washed from a sea otter, but the solutions used also remove the otters' hair oils which decreases the fur's insulating capability. Recent investigations by Kooyman and Costa at Scripps Institute of Oceanography reveal that

oiled sea otters suffer abnormal metabolic rate increases and body temperature declines. Moreover, the investigations suggest that it takes a minimum of 15 days for the otter's metabolic rate to return to normal after initial oil contact and human cleaning.

4. Commercial and Sports Fishing. California Department of Fish and Game (CDF&G) maintains long-term catch records for sport and commercial fish harvests with the emphasis on commercial species and provides estimates of population abundances and distribution for many fish species. The National Marine Fisheries Service (NMFS) has data on species caught farther offshore and foreign fishing catches in U.S. waters.

The CDF&G also maintains an active program of research and analysis related to commercial and recreational fish and shellfish species. CDF&G conducts ocean surveys annually for management and prediction of the abundance of these species. Market sampling teams are located in Eureka, Ft. Bragg, Menlo Park, Monterey, Morro Bay and Santa Barbara. The National Marine Fisheries Service (NMFS) also conducts fisheries surveys in the area as well as the ichthyoplankton samples taken as part of the CalCOFI program. The NMFS Coastal Fisheries Resources Division conducts research projects related to specific problems affecting the survival of coastal and pelagic fishes with commercial or recreational value.

Fisheries research is also conducted at Humboldt State University by the Federal cooperation program in Humboldt Bay and the foreign Hake fishery study. Oregon State University and the University of Washington fisheries research programs sample salmon populations in northern California. Anadromous fisheries are important in northern California for three species of salmon as well as shad, steelhead and striped bass.

The limited information available for oil effects on fish species for northern California was described above under Special Biological Areas and Habitats. Since there have been no OCS development activities off northern California, there is no history of fishery - OCS development conflicts.

5) Recreation and Aesthetics. The California Coastal Plan and Chapter III-8 of the Winzler and Kelley Summary of Knowledge describe in detail the recreational resources and uses for northern California. Although data are available on sports fishing catches from the California Department of Fish and Game, there is no quantitative information available on the number of sport fishing vessels for the coast, how many people use the vessels per year, and where the greatest fishing intensity occurs by area and time of year.

The Winzler and Kelley report briefly reviews potential impacts of OCS development on recreational activities in northern California. However, this analysis is not related to potential OCS development scenarios for Sale 53 which will be developed after tract selection in October, 1978.

6) Shipping and Navigation Conflicts. The U.S. Coast Guard is responsible for collecting shipping information for the area. Chapter III-3 of the Winzler and Kelley report summarizes available information on shipping activity in the area, mainly shipping activity in major ports along the coast.

As part of the environmental impact analysis for the proposed SOHIO project to transport Alaskan crude oil by tanker to Long Beach, California, Tetra Tech, under a contract from the Army Corps of Engineers, conducted an analysis of tanker collisions and oil spill trajectories based on various scenarios. The analysis is part of the final environmental impact statement for the SOHIO project. This is the only known offshore shipping analysis available for the area.

At a preliminary tract selection meeting in July, 1978 at the Pacific Outer Continental Shelf Office in Los Angeles, the Coast Guard announced new proposed traffic separation lanes for shipping off the northern California coast. These proposed sea lanes will be outside the tract selection areas for OCS leasing displayed in Figure 4, except for the area off San Mateo county south of San Francisco. BLM will continue to coordinate with the Coast Guard to eliminate major conflicts between shipping and OCS development at subsequent leasing decision points.

7) Archaeological and Cultural Resources. Chapter III-7 of the Winzler and Kelley report summarizes available coastal and offshore information for archaeological and cultural resources in northern California. There have been several shoreline historical studies along the coast to identify and catalog cultural resources, but there is no offshore information along the coast except for the Drake's Bay area of the Pt. Reyes Peninsula. This investigation was conducted at the skin diving level only. There has been some archaeological consultation in San Francisco Bay with the U.S. Geological Survey concerning Bay history chronology.

There is no predictive or damage risk assessment for offshore and coastal archaeological and cultural resources related to OCS oil and gas development for northern California.

8) Infrastructure and Social Conflicts. Chapters III-1 through 5 of the Winzler and Kelley report summarize socioeconomic data for the northern California coastal counties. The California Coastal Plan also describes coastal socioeconomic conditions and lists policies for protecting significant coastal resources from major disruptive uses. Generally, the northern California coastal zone is sparsely populated except for population centers around San Francisco, Eureka, and Monterey Bay. Heavy industrial and commercial activities are concentrated only in the San Francisco area along the entire northern California

coastline. Natural resource industries such as logging and fishing are an important segment of the local economy north of San Francisco, while tourism and recreational uses contribute substantially to socioeconomic conditions along the entire coast.

There have been no specific predictive studies concerning potential impacts on the northern California infrastructure and populations from offshore oil and gas development to date, since there has been no State or Federal development offshore northern California except for the brief exploratory activity on federal leases in the early 1960's discussed previously in Chapter II of this plan. Local, State and federal government agencies are increasing their coordination efforts to resolve major conflicts between energy development and socioeconomic stability in the coastal zone. The Coastal Energy Impact Program, administered by the Office of Coastal Zone Management in the National Oceanic and Atmospheric Administration, makes federal funds available to local governments to assess the impacts of energy development in their area.

#### 9) Geologic Hazards.

a. Engineering Properties. Engineering studies of sediments have been conducted in shallow waters of the northern California OCS, but these studies have been predominantly in State waters and in very localized coastal areas such as electrical power plant sites in Humboldt Bay, San Francisco Bay, Elkhorn Slough in Monterey Bay, Morro Bay, a proposed nuclear site at Pt. Arena and a nuclear plant at Diablo Cove near San Luis Obispo Bay. As mentioned previously, proposed municipal sewage outfalls along the coast also require engineering studies. The Army Corps of Engineers has conducted studies in San Francisco Bay concerning the effects of dredging in the bay and the Sacramento River Delta. There are no offshore platforms on the northern California OCS, but engineering studies have been performed for offshore platforms placed in federal and State waters in the Santa Barbara Channel.

b. Sediment Distribution Studies. Surface sediment distribution has been mapped and characterized for offshore California on a broad scale. Available offshore geologic and oceanographic data for central California are displayed on two charts: "Oceanographic Data of the Monterey Deep Sea Fan" and "Oceanographic Data Off Central California 37° to 40° North including the Delgada Deep Sea Fan". These maps display several sediment stations taken in lines off Monterey and San Francisco Bays as well as several stations inside these two bays, but few sediment stations in other areas.

The U.S. Geological Survey (USGS) is comparing five areas along the West Coast (southern Washington, southern Oregon-northern California, central California, Santa Barbara and southern California) to identify and understand sedimentary and depositional processes. The USGS is also studying sedimentary and geochemical processes in San Francisco Bay. A Sea Grant Project being conducted by the University of California at

Berkeley is examining areas of the central California OCS for potential for sand and gravel mining. The study includes analysis of grain size distribution and plotting of data on computer maps. Beach, lagoon, slough, and other nearshore environments are the subject of continuing sediment distribution studies by the U.S. Army Corps of Engineers.

c. Slope Stability. Sediment sampling and profiling have been conducted on the shelf by universities, the USGS, the U.S. Navy, and the oil industry. However, coverage is not uniform and potential hazards are not well known. The Monterey submarine canyon has been investigated by geologists at Moss Landing Marine Laboratory and the Naval Postgraduate School in Monterey.

d. Seismic Events. The offshore stratigraphy and seismic history of northern California are not well known because sampling and coring localities and geophysical surveys are too widespread to make detailed analyses. In most cases, onshore data have been extrapolated offshore to define structures and, therefore, suspected active seismic areas are based on inference. No bottom seismometers have been placed on the shelf floor to record seismic events. Some earthquake epicenters are known offshore central California and are plotted on the maps described above. However, there are no detailed data for the shelf north of San Francisco to the Oregon border. Therefore, the magnetic and seismic reflection data that exist for offshore northern California only serve to provide a general picture of geologic features and history of seismic events.

As discussed in Chapter II, USGS has collected additional seismic reflection data offshore northern California and purchased additional high-resolution data to evaluate potential hazards. The Conservation Division of USGS will be evaluating proprietary data from exploratory test wells drilled in the late 1960's in northern California.

B. Outside Scientific Assessment. By circulating this plan to the scientific community and other government agencies, BLM hopes to obtain critical review and comment on: 1) The adequacy of the existing information base to answer the management questions listed in Chapter III within the timeframe of future leasing and development activities in Chapter II for FY 1979-80; and, 2) past and new approaches to gain information to answer the predictive impact assessment and cost analysis questions posed for these management questions.

#### CHAPTER V. PROPOSED NORTHERN CALIFORNIA STUDY TOPICS FOR FY 1979 and 80

This chapter describes the relationship between planned BLM environmental assessment activities for Sale 53 in FY 1979 and 80 and proposed study topics. As discussed in previous chapters, the information needs for these leasing decisions in this time period are:

1. Prediction of major impacts from OCS development activities and the significance of these impacts related to the issues described in Chapter III for use in the environmental statement process.

2. Information to develop cost effective and adequate mitigating measures such as lease stipulations, alternatives to the proposed action, and changes in OCS Operation Orders to reduce the detrimental impacts. This information will be used in the environmental statement process and the SID.

3. Information to estimate social costs or benefits for each of the identified issues and mitigating measures. This information will also be used in the SID and the final tract selection decision.

The study design and approach for several of these proposed study topics will be closely coordinated with USGS, FWS, and NPS; other responsible federal agencies; and the State of California.

A. Planned BLM Environmental Assessment Activities for Sale 53 in FY 1979 and 80. The BLM staff at the Pacific OCS Office and the Washington Office will be gathering information for the Sale 53 draft and final environmental impact statements in FY 1979 and 80. Therefore, a contract study will not be needed for every issue and question described in Chapter III. Many of the issues and questions can be addressed with existing information. The Pacific OCS Office has prepared a Unit Resource Analysis (URA) for northern California based on the Winzler and Kelley Summary of Knowledge, as well as information from other available sources. This environmental and socioeconomic information will be updated by the staff throughout 1978-1979.

USGS will be providing BLM with proposed development scenarios for Sale 53 after tract selection in October, 1978. These development scenarios will be the basis of the impact analysis in the environmental statement. To help analyze socioeconomic impacts from these development scenarios, BLM will employ the Curtis Harris Socioeconomic Model developed at the University of Maryland. This computer model uses the development scenarios provided by USGS to analyze projected economic activity for industrial, commercial, and consumer sectors on a county level. This model is run by the University of Maryland under contract to BLM for each OCS lease sale.

To help analyze potential oil spill trajectories and impacts from Sale 53, BLM will be contracting to USGS to run an Oil Spill Trajectory Model developed by the Reston, Virginia USGS Office. This model will use the USGS development scenarios for Sale 53 and the best available wind and surface current data to predict major oil spill trajectories and to develop probabilities of major spills hitting various resources and coastal land segments in northern California.



B. Proposed Study Topics. The following proposed study topics are described in relation to issues, major impacts, and management questions described in previous chapters. Each study topic was evaluated by the significance matrix in Tables 6 and 7. The tables give two examples of working through the matrix for a given issue or question. The issues are ranked by priority for FY 1979 and 80. As discussed previously, this plan will be reviewed annually by the the public and the scientific community and revised by June of each calendar year. The present ranking could change during FY 1979 based upon funding and manpower availability.

#### 1. Marine Bird and Mammal Impacts

Decision to be affected: Threatened and endangered species consultation needs for Sale 53, Secretarial Issue Document (SID), final tract selection, Operating Orders, lease stipulations.

Decision Timing: Mid 1980 to early 1981

Activity or Technology Affected by Decisions: Mix of tracts offered in lease Sale 53, threatened and endangered species consultation process with FWS, drilling and operating activities.

#### Significant impact producing agents:

Human disturbance from structure placement, machinery noise, and routine servicing of rigs and platforms by boats and aircraft; acute and chronic oil spills; chronic discharges from normal operations.

#### Decisionmaker's, Mid-Level, and Technical Questions:

Refer to Chapter III., C.3.

Degree of Detail: Seasonal; area resolution of 3 to 10 km of coastline; semi-quantitative data

#### Types of Studies Needed:

(1) Marine Bird and Mammal Reconnaissance Survey of Proposed Lease Areas for Sale 53. Since there is a substantial amount of available data on rookeries, nesting areas, and coastal habitats for marine bird and mammal populations in northern California, this survey would concentrate on the offshore environment where little or no data exists. The study would concentrate on the tentative tract selection areas for Sale 53 and obtain seasonal data for bird and mammal distribution and abundance at sea. The study would also summarize and analyze all available data for coastal and island habitats for significant bird and mammal species most likely to be affected by OCS development activities. The products would identify and map critical breeding areas, migratory pathways, foraging areas, and nesting habitats for the major populations in the area by season.

Table 6 SIGNIFICANCE MATRIX  
FOR MARINE BIRD AND MARINE MAMMAL ISSUES

TOP-DECISION MAKER.....MANAGER.....SCIENTIST.....														
ITEM OR QUESTION	Type of Conflict	Cause	Importance of Item Question	Description of Information Base-Existing Conditions	Information Necessary to:	Item's Priority								
What will be the significant impacts from OCS development activities on marine bird and mammal populations and habitats in northern California?	Yes	Yes	High	Offshore and Onshore exploration and development; primarily development	Yes	USFWS, NMFS, Marine Mammal Commission, California DFG								
	Yes	Yes	Low to potentially very high	Short and long term	Irreversible for some impacts	Yes, for some coastal habitats; No, for offshore habitats; some impact data available								
		No	No	Location of impact	Is it available?	Is it quantifiable?								
	Is it a physical contact?	Is cause due to economics?	Is an alternative resource available?	Agency responsible for collecting it	Is it feasible to obtain?	Who is capable of collecting it?								
	Is it a space-use conflict?	Is cause due to technology?	Short/long term	Is it mappable?	When can it be obtained?	Describe								
		Is cause due to society?	Degree of severity	Is it quantifiable?	Explain	Predict								
		Is cause due to environment?	Irreversible/Reversible	Is it available?	Coastal data available; no offshore data; some impact data available	Some available; long-term, chronic impacts unknown; disturbance impacts for areas unknown								
					Not available; need pollutant trajectory models; need risk and cost/benefit analyses									

Table 7. SIGNIFICANCE MATRIX  
FOR GEOLOGIC HAZARD ISSUE

TOP-DECISION MAKER.....MANAGER.....SCIENTIST.....						
ITEM OR QUESTION	Type of Conflict	Cause	Importance of Item Question	Description of Information Base-Existing Conditions	Information Necessary to:	Item's Priority
What will be the losses in oil and gas resource value and the potential impacts from geologic hazards in northern California?	No	Is it a physical contact?	Is it a physical contact?	Is it available?	Describe	Not available yet; need field work
	Yes	Is cause due to environment? Is cause due to economics? Is cause due to society? Is cause due to technology?	Level of impact certainty Location of impact Stage of OCS Development Is it a cumulative impact? Is an alternative resource available? Degree of severity Short/Long term Irreversible/Reversible	Is it quantifiable? Is it mappable? Is it feasible to obtain? Agency responsible for collecting it Who is capable of collecting it? When can it be obtained?	Explain Predict	Not available yet Not available; need field work, data analysis, development action, cost/benefit analysis

In addition to the above products, the study would evaluate available information on major impacts from OCS oil and gas development activities on marine birds and mammals, make conclusions concerning the significance of the impacts for the area, recommend realistic mitigating measures for BLM to consider, and conduct a cost/benefit analysis of the proposed mitigating measures.

(2) Summary and Analysis of Available Physical Oceanographic and Meteorological Data for Northern California. BLM will enter into an interagency agreement with the National Oceanic and Atmospheric Administration (NOAA) to summarize and analyze the available historical data in the national archives for physical oceanography and meteorology offshore the entire California coast in FY 1979. The study will start in November, 1978. This study will emphasize analysis of surface currents and wind data required for the USGS oil spill trajectory model for Sale 53. Therefore, the oil spill trajectory model will be using the best available information to predict major spill trajectories on marine bird and mammal population concentrations and habitats based on the proposed development scenarios for Sale 53. This study will also summarize the available historical data for severe storms and oceanographic events (e.g., tsunamis) along the coastline.

(3) Fate and Effects of Oil on Selected Bird Species. Although the short-term, acute effects of oil spills on several bird species are well-known, the long-term, sublethal effects of oil on bird species and populations are poorly known and are just starting to be investigated. The BLM realizes that the FWS and other regional organizations are now conducting investigations to answer the long-term effects questions for bird species. After coordination with the FWS, BLM will consider providing funds for long-term oil fate and effects studies for selected bird species in northern California.

## 2. Impacts on Special Biological Areas and Habitats Including Threatened and Endangered Species Habitats

Decision to be affected: Secretarial Issue Document (SID), final tract selection, lease stipulations, operating orders, threatened and endangered species consultation needs for Sale 53.

Decision timing: Late 1980 to early 1981

Activity or technology affected by decisions: Mix of tracts offered in lease Sale 53, threatened and endangered species consultation process with FWS, drilling and operation activities.

Significant impact producing agents:

Structure and structure placement; discharges of drill cuttings, drilling muds, sewage, and debris from normal operations; acute and chronic oil spills.

Decisionmaker's, Mid-Level, and Technical Questions:  
Refer to Chapter III.C.2.

Degree of Detail: Seasonal; area resolution of 3 to 10 tracts or 10 km coastline, semi-quantitative data.

Types of Studies Needed:

(1) Biological Characterization Study of Marine and Coastal Habitats. Although there are many identified technical questions covering a wide range of potential investigations, the critical information that is needed first is to identify and describe the biological habitats, populations, and processes in or adjacent to the proposed lease areas. The BLM will be entering into a Memorandum of Understanding with the FWS to conduct an Ecological Characterization of the Central and Northern California Coastal Region. The specific objective of the study is to obtain and synthesize available environmental data for the central and northern California Coastal Region which identify and describe important resources, ecological processes, and their interrelationships within the study area and to provide an analysis of their functional relationship. The study will also summarize and analyze available data for special biological habitats potentially affected by OCS development activities including available information on endangered and threatened species and habitats. The study products will identify and map critical offshore and coastal habitats and describe why they are critical or special.

In addition, the study will identify critical data gaps and processes in need of additional study to answer questions about the significant effects of OCS oil and gas development on biological resources and habitats in central and northern California.

(2) Summary and Analysis of Available Physical Oceanographic and Meteorological Data for Northern California. This is the same study described above under Marine Bird and Mammal Impacts and will provide information to use in the USGS oil spill trajectory model described previously.

(3) Fates and Effects of Oil on Marine Organisms. This study topic would be handled at the national level by the BLM Washington Office in coordination with other ongoing oil fate and effects programs as described in Chapter I of this regional plan and also in the national plan.

### 3. Air Quality Impacts

Decisions to be affected: SID, final tract selection, lease stipulations, operating orders.

Decision timing: Late 1980 to early 1981.

Activity of technology affected by decisions: Mix of tracts offered in lease Sale 53, offshore emissions from OCS development facilities.

Significant impact producing agents: Offshore emissions from normal development and production activities, including oil and gas transportation; air pollution emissions from major oil spills.

Decisionmaker's, Mid-Level and Technical Questions: Refer to Chapter III.C.1.

Degree of detail: Seasonal; areal resolution of 3 to 10 tracts or 10 km of coastline; quantitative.

#### Types of Studies Needed:

(1) Air Quality Trajectory Modeling and Evaluation of Major Impacts for Various Sale 53 Development Scenarios. This study would describe the existing air quality conditions and standards in the area; model air pollutant emissions from OCS development and production activities based on proposed development and production activities based on proposed development scenarios; estimate and model air pollutant emissions from major predicted oil spills; conclude whether or not air quality standards would be violated from various OCS development activities and production levels; recommend effective mitigating measures for reducing the major impacts identified; and conduct a cost/benefit analysis of the proposed mitigating measures and major impact levels.

(2) Summary and Analysis of Available Physical Oceanographic and Meteorological Data for Northern California. This is the same study described previously under Bird and Mammal Impacts. It will provide the best available wind information for the area to use in the air quality modeling study described above.

#### 4. Geologic Hazards

Decision to be affected: SID, final tract selection, lease stipulations, operating orders.

Decision timing: Late 1980 to early 1981.

Activity or technology affected by decisions: Mix of tracts offered in lease Sale 53, drilling practices, types of completions, location and types of rigs and platforms, pipeline routes.

Significant impact producing agents: Active submarine faults; sediments; areas of potential slumps, creeps or landslides, shallow gas pockets.

Decisionmaker's, Mid-Level, and Technical Questions: Refer to Chapter III.C.9.

Degree of detail: Short-term; tract specific area resolutions and 2-5 km of coastline; semi-quantitative.

Type of Study Needed:

Offshore Geologic Hazards Study of Proposed Lease Areas for Sale

53. As discussed in Chapter II, the USGS Geological Division is conducting a geologic hazards study and evaluation in northern California in the Eel River Basin area under a Memorandum of Understanding (MOU) with BLM. BLM will consider joint funding with USGS for additional hazards work in proposed lease areas identified by tract selection for Sale 53. These hazard studies should not only identify and map potential hazards, but also evaluate their probability of occurrence and the significance of major impacts on OCS development activities based on current operating technology. BLM will coordinate with USGS on any other geological hazards studies and will work with USGS to develop realistic mitigating measures to reduce potential impacts and evaluate the costs of the proposed mitigating measures.

5. Shipping and Navigation Conflicts

Decision to be affected: SID, final tract selection.

Decision timing: Late 1980 to early 1981.

Activity or technology affected by decision: Mix of tracts offered in Lease Sale 53, placement of development and production facilities, U.S. Coast Guard and Army Corps of Engineer regulations.

Significant impact producing agents: Offshore rigs and platforms; boat traffic servicing these facilities; major oil spills.

Decisionmaker's, Mid-Level, and Technical Questions: Refer to Chapter III.C.6.

Degree of detail: Short-term; areal resolution of 3 to 10 tracts or 10 km of coastline; semi-quantitative.

Type of study needed: Since BLM and the Department of the Interior coordinate closely with the Coast Guard and the Corps of Engineers throughout the leasing and development process, many of the shipping conflicts with OCS development activities are avoided at an early stage. As discussed previously in chapter IV, the new proposed sea lanes for northern California are outside of most of the high interest areas for Sale 53. After further consultation with the Coast Guard, BLM will consider funding a study to predict major impacts and risks to shipping for proposed OCS development scenarios for Sale 53.

## 6. Commercial and Sports Fishing Impacts

Decision to be affected: SID, final tract selection, lease stipulations, operating orders.

Decision timing: Late 1980 to early 1981.

Activity or technology effected by decisions: Mix of tracts offered in lease sale 53, types of development and production facilities, placement of development and production facilities, drilling and operating activities.

Significant impact producing agents: Structures and structure placement; discharges of drill cuttings, drilling muds, sewage, and debris from normal operations; acute and chronic oil spills; pipelines.

Decisionmaker's, Mid-Level, and Technical Questions: Refer to Chapter III.C.4.

Degree of Detail: Seasonal, areal resolution of 3 to 10 tracts or 10 km of coastline; semi-quantitative.

### Types of Studies Needed:

(1) Analysis of Commercial and Sports Fishing Impacts in Northern California from Proposed OCS Sale 53 Development Activities. This study would analyze the considerable data and catch statistics available from the California Department of Fish and Game and the National Marine Fisheries Service to identify and quantify the major fishing areas in northern California and their regional economic value. From analyses of the various proposed OCS development scenarios, the results of the oil spill trajectory model and historical data on OCS development and fishing conflicts in other already developed OCS areas, this study would describe, predict, and quantify the potential major impacts and conflicts from Sale 53 on commercial and sports fishing in northern California. The study would also recommend effective mitigating measures for BLM to consider based on the development scenarios and the oil spill model results to reduce major impacts on commercial and sports fishing. This analysis would use computer modeling techniques and cost/benefit analysis to quantify the levels of impacts and the effects of the proposed mitigating measures.

This study will be coordinated with the Fish and Wildlife Service, and National Marine Fisheries Service, California Department of Fish and Game, and local fishermen's cooperatives.

(2) Summary and Analysis of Available Physical Oceanographic and Meteorological Data for Northern California. This is the same study described previously under Bird and Mammal Impacts. It will provide the best available current and wind information for the area to use in the USGS oil spill trajectory model described previously.



## 7. Impacts on Archaeological and Cultural Resources

Decision to be affected: SID, final tract selection, lease stipulations, operating orders.

Decision timing: Late 1980 to early 1981.

Activity or technology affected by decision: Mix of tracts offered in lease Sale 53, placement of development and production facilities, drilling and operating activities.

Significant impact producing agents: Structures and structure placement; acute and chronic oil spills; pipelines.

Decisionmaker's, Mid-Level, and Technical Questions: Refer to Chapter III.C.7.

Degree of Detail: No temporal resolution; tract specific or 2-5 km of coastline; semi-quantitative.

Type of Study Needed: After further coordination with the Heritage Conservation and Protection Service and the State of California, BLM will consider funding a study to map sensitive offshore and coastal cultural resources in or adjacent to proposed lease area for Sale 53. Based on the proposed development scenarios and the results of the oil spill trajectory model, this study would identify major impact areas; predict expected damage; propose effective mitigating measures for BLM to consider to reduce the major impacts; and, conduct a cost/benefit analysis of the proposed mitigating measures.

## 8. Recreation and Aesthetic Impacts

Decision to be affected: SID, final tract selection, lease stipulations, operating orders.

Decision timing: Late 1980 to early 1981.

Activity or technology affected by decision: Mix of tracts offered in lease Sale 53, placement and types of development and production facilities.

Significant impact producing agents: Offshore and onshore development and production facilities; major oil spills.

Decisionmaker's, Mid-Level and Technical Questions: Refer to Chapter III.C.7.

Degree of detail: Annual; areal resolution of 3 to 10 tracts or 10 km of coastline; semi-quantitative.

Type of study needed: Since there is considerable information available from the National Park Service and the California Department of Parks and Recreation on the locations and uses of the recreational resources in northern California, any study that BLM will consider funding would concentrate on describing, predicting and quantifying the major impacts and their costs based on proposed development scenarios for Sale 53. The study would identify effective mitigating measures and conduct a cost/benefit analysis of the proposed mitigating measures. BLM will coordinate with the appropriate federal agencies and the State of California before developing such a study.

## CHAPTER VI. SCHEDULING AND AVAILABILITY OF RESULTS

### A. Scheduling

Table 8 summarizes BLM's proposed OCS environmental studies activities for FY 1979 and 80. As discussed previously, BLM will continue to coordinate with other federal agencies, the State of California, the scientific community, and public interest groups to develop studies that will provide information in the proper format and in time for use in OCS management decisions in the leasing and development process. The Pacific OCS Office is developing detailed work statements for several of these studies in cooperation with other federal agency scientists and the State of California. The study priorities are as listed in Chapter V. After work statements are prepared, BLM will develop Memorandum of Understanding (MOU's) with other federal agencies or requests on proposals (RFP's) for competitive procurements to conduct the studies.

### B. Availability of Results

Final reports of all studies funded by the Bureau of Land Management are available to the public. In order to ensure the widest possible availability of each report in the most practical manner, the BLM transmits the master copy of each report to the National Technical Information Service for publication upon request in either paper or microfiche. Appendix D lists all reports currently available that have resulted from BLM environmental studies on the west coast, along with their prices and sources.

Recognizing that some of the more massive reports may be prohibitively expensive, the Pacific OCS Office has distributed a limited number of paper and microfiche copies of all reports to selected governmental, academic, or other public institutions. Interested parties may consult the attached list of such repositories for the one nearest them.

A long lead time is often required to implement a study and see it through to an acceptable final product. While studies targeted to a particular decision step will have to be completed well in advance of the anticipated action, most studies will relate to more than one

decision. Therefore, information assessment relevant to an interim requirement is routinely assembled by BLM field office personnel while a study is underway. Progress reports discussing initial findings and results submitted on a monthly or semi-annual basis, are received from each contractor for this purpose. Because of the limited and cumulative nature of this material, it is impractical to publish early findings on a programmed basis. However, investigators are encouraged to publish such information in appropriate magazines, journals, or other professional references.

Every two months, the Pacific OCS Office distributes an Environmental Studies Field Report which briefly summarizes progress on each contract, coordination activities and pertinent results. Interested agencies have found this a useful forum by which to track progress and interim information. The Pacific OCS Office encourages and welcomes queries or comments on any of its environmental studies, and invites suggestions for better resolution of significant and timely issues.

Table 8. SUMMARY OF PROPOSED REGIONAL STUDY PROGRAM ACTIVITIES - FY 1979 and FY 1980

Northern California Regional Studies Plan				
Sale Number/ Decision Date	Sensitivity Issue	Information Needs (Status) <sup>1</sup>	Date Information Needed (Step)	Studies Needed
53 - 1/81	<p>Marine mammals and seabirds - Impact of OCS oil and gas activities on marine mammals and seabirds.</p> <p>The Sea Otter has been identified as a threatened and ecologically vulnerable to oil spills.</p>	<p>Distribution and abundance of coastal and island habitats (breeding, foraging).</p> <p>Significant impacts and mitigating measures for birds and mammals.</p>	1/80 (085)	Marine mammal and seabird reconnaissance survey (FY 1979)
	<p>1. Review of sale with stipulations</p> <p>2. Design of stipulation or mitigating measure to reduce environmental risk at a tract or multi-tract level.</p>		6/80 (725)	<p>Fate and effects of oil on California Sea Otter (FY 1979)</p> <p>Fate and effects of oil on selected bird species (FY 1979)</p> <p>Marine mammal and seabird reconnaissance (FY 1980)</p> <p>Fate and effects of oil on selected bird species (FY 1980)</p>
	Study timing must accommodate withdrawal of the Draft Final Environmental Statements and the Secretarial Issues Document to permit consideration of stipulations.	Oil Spill Trajectories Physical Oceanographic Data Weather Data Marine Mammal Data (other issues also)	1/80 (085)	Summary and analysis of historical physical oceanographic data and weather data (FY 1979, FY 1980)
	Impacts on special biological areas and habitats, including threatened and endangered species habitats by OCS oil and gas activities (Endangered Species Act)	Habitat type and community studies of endangered, threatened, protected or unique species	1/80 (085)	Biological reconnaissance survey of selected subtidal and intertidal habitats (FY 1979)
		Oil spill trajectory inputs (3)	1/80 (085)	Biological reconnaissance survey of selected subtidal and intertidal habitats (FY 1980)

## Status Legend

- (1) Information available  
(2) Study underway; usable information will be available for this decision  
(3) Applicable study already proposed for earlier decision

## SUMMARY OF PNW DSID REGIONAL STUDY PROGRAM ACTIVITIES - FY 1979 and FY 1980

## Northern California Regional Studies Plan

Decision Point	Sale Number/ Decision Date	Sensitivity Issue	Information Needed (Status)	Date Information Needed (Slip)	Studies Needed
Sale (Notice of Sale with Mitigation)	53 - 1/81	Geologic hazards in Northern California OCS area - Earth- quake epicenters are known offshore Central and Northern California.	Geologic hazards of Eel River Basin area (N. California) (FY 1977, USGS study). (1) Geologic hazards of other areas - after 9/78 tract selection	1/80 (DES)	Offshore geologic hazards study of proposed lease areas (FY 1979)
(continued)		Preservation and protection of antiquities, historic and prehistoric sites, shipwrecks and other cultural resources. Concern over potential degrada- tion of ambient quality in reservoirs regulating Federal and State Standards	Geohazards - mitigating measures/costs.  Archaeological and cultural resource survey of N. California (literature survey, sensitivity zone mapping).  Existing air quality conditions. Model of air pollutant emissions for various scenarios (oil spill, fires). Air Quality, mitigating measures/cost.	1/80 (DES)  1/80 (DES)  1/80 (DES)	Offshore geologic hazards study (mitigation) (FY 1980)  Archaeological and cultural resource, literature survey (FY 1979)  Air quality trajectory model- ing and evaluation of major impacts for various Sale 53 development scenarios (FY 1979)
			Physical oceanography and meteorologi- cal data. (3)	8/80 (SID)  1/80 (DES)	Air quality modeling and evaluation of mitigating measures. (FY 1980)

## Status Legend

- (1) Information available  
(2) Study completed  
(3) Applicable study already proposed for earlier decision

## SUMMARY OF PROPOSED REGIONAL STUDY PROGRAM ACTIVITIES - FY 1979 and FY 1980

## Northern California Regional Studies Plan

Decision Point Solv. (Notice of Sale with Evaluations)	Sale Number/ Decision Date	Sensitivity Issue	Information Needs (Status) <sup>1</sup>	Date Information Needed (Step)	Studies Needed
(continued)	53 - 1/81	Impacts of OCS oil and gas activities on commercial and sport fishing.	Commercial and sports fish and shellfish apition.	8/80 (SID)	Analysis of commercial and sport fishing impacts (FY 1979)
			Commercial and sport fishing areas.	8/80 (SID)	
			Types of gear used and conflicts with OCS oil and gas activities.	8/80 (SID)	
			Oil spill trajectory inputs. (3)	8/80 (SID)	
		Conflict of OCS oil and gas activities on shipping and navigation activities.	Number and location of surface structures.	6/80 (FES)	Shipping and navigation conflicts, literature survey and analysis (FY 1979)
			Intensity of shipping and shipping lanes. (1)	6/80 (FES)	
			Historic damage (ref: shipping) (1)	6/80 (FES)	
		Degradation of recreation areas	Literature survey of recreation (1)	8/80 (SID)	Recreation and aesthetics impacts, literature survey and analysis (FY 1979)
		OCS oil and gas activity impact on aesthetics of Northern California.	Aesthetic resources in Northern California. Cost/benefit analysis of the proposed mitigating measures.	8/80 (SID)	
			Oil spill trajectory inputs. (3)	8/80 (SID)	

## Legend

- (1) Information available  
(2) Study underway; usable information will be available for this decision  
(3) Applicable study already proposed for earlier decision

## SUMMARY OF PROPOSED REGIONAL STUDY PROGRAM ACTIVITIES - FY 1979 and FY 1980

## Northern California Regional Studies Plan

Decision Point	Study Number/ Decision Date	Sensitivity Issue	Information Needs (Status) <sup>1</sup>	Date Information Needed (Step)	Studies Needed
Exploration Plan Approval Data provided for this decision will be used under SO-2974 for BLM recommendations to USGS regarding investigation of stipulations, adjustments of drilling sites, and other constraints on exploration activity.	53 - 11/81	Preservation and protection of antiquities, historic and pre- historic sites, shipwrecks, and other cultural resources.	Archaeological and cultural resource survey of N. California, literature survey and sensitivity zone mapping. (3)	8/81 (EPA)	
		OCS oil and gas conflicts with shipping and navigation activities (exploratory phase)	Number/location of surface structures. (3)	8/81 (EPA)	
			Intensity of shipping (shipping lanes). (3)	8/81 (EPA)	
			Historic damage (ref: shipping). (3)	8/81 (EPA)	
		Degradation of recreation areas and , OCS oil and gas activity on aesthetics of N. California.	Analysis of proposed mitigating measures in reference to recreation and aesthetics concerns. (3)	8/81 (EPA)	

## Footnote Legend

- (1) Information available  
 (2) Study underway; unable information will be available for this decision  
 (3) Applicable study already proposed for earlier decision

## SUMMARY OF PROPOSED REGIONAL STUDY PROGRAM ACTIVITIES - FY 1979 and FY 1980

Northern California Regional Studies Plan			
Decision Point	Site Number / Decision Date	Scientific Issue	Information Needs (Status)
Development Plan Approval and Plan for Light-of-day data provided for this decision will be used: 1. Under SO-2974 for RM recommendation to ESO5 regarding options under OCS development and over- board fishing. (Status: 1) 2. All planning and over- board fishing production and onshore production distribution, and processing (e.g., location, atpula- tions, discharges, pipeline burial, etc.) 3. To determine nearshore and socioeconomic impacts.	53 - 8/82	Geologic hazards in Northern California - Earthquake opti- mizers are know offshore this area.  OCS development impacts on commercial and sport fishing.  OCS development impacts on shipping and navigation activities.  OCS development: Impact on the recreational areas and the aesthetics of N. California.  Trajectory of oil spills on the OCS.	Geologic hazards of leased areas. (3)  Types of OCS structures and their conflict with the different types of fishing gear used. (3)  Type and location of OCS structures, intensity of shipping, history of damage. (3)  Analysis of proposed mitigating measures. (3)  Synthesis of historic physical oceanographic and climate data. (to refine inputs to present models) (3)
			11/82 (DPA)  11/82 (DPA)  11/82 (DPA)  11/82 (DPA)  11/82 (DPA)
			Studies Needed

## Status Legend

- (1) Information available  
 (2) Study underway; unable to determine if information will be available for this decision  
 (3) Applicable study already prepared for earlier decision



APPENDIX A

Description of Steps in the Decision-Making Process

## DESCRIPTION OF STEPS IN DECISIONMAKING PROCESS

## 1. Tentative Sale Schedule

OBJECTIVES: To provide a framework for orderly development of OCS resources  
 To provide advance notice of proposed leasing actions to the public  
 To program the timing of Departmental pre-leasing steps and  
 prioritize issue development by region.

CONTENT/FORMAT: One page showing tentative sale dates and timing of pre-sale  
 steps for a four to five year period

TIMING: Revised periodically, historically approximately bi-annually;  
 OCS Lands Act amendments would require annual update

MANDATE: Departmental policy based on OCS Lands Act requirement for orderly  
 resource development

PRIMARY BASES: Regional resource and environmental data, current energy  
 situation, industry capabilities, availability of technology,  
 proximity of resources to market, general hazards to development,  
 desirability of regional development based on recommendations  
 by States and others.

ASSOCIATED DECISIONS: The final selection of a tentative sale schedule is  
 the culmination of a series of relational judgments regarding  
 potential development of one area as opposed to another, and  
 regarding the sequencing of sale scheduling within each area.  
 Qualifying parameters used in these judgments include orderly  
 development, protection of the marine environment,  
 gradual development of all frontier areas, current and projected  
 energy supply picture.

RESPONSIBLE PARTIES: BLM in consultation with POCS drafts schedule and options.  
 Options reviewed by AS/PBA and AS/L&WR. Director, BLM recommends  
 one option. Final selection by Secretary. Signed by Director, BLM.

INPUT GROUPS: BLM, USGS, FWS, POCS, AS/PBA, AS/L&WR, States, industry,  
special interests

AVAILABLE DOCUMENTATION: First tier of two-tier nomination report; regional  
resource estimates by USGS; other comments, recommendations,  
and data offered by anyone.

## 2. Call for Nominations

OBJECTIVES: To solicit industry's interest in specific tracts within a  
defined geographic region  
To initiate the pre-leasing coordination process  
To receive positive or negative nominations and comments from  
Federal and State agencies and the public  
To begin to focus information needs on areas where there might  
be leasing activities and where issues are being more clearly  
defined.

CONTENT/FORMAT: Federal Register notice indicating geographic boundaries of  
call area, criteria and format for nominations (both positive  
and negative), closing date

TIMING: Identified on leasing schedule, and generally held to unless  
major objection. Call generally open 50-70 days.

MANDATE: 43 CFR, part 3300, subpart 3301.3

PRIMARY BASES: Resource Reports from Federal and State agencies, estimates  
of desired sale size, areas of special significance to be excluded  
from call area.

ASSOCIATED DECISIONS: Evaluation of Resource Reports and resource estimates  
and any actions to limit call area or identify preliminary  
stipulations that may apply to certain tracts

RESPONSIBLE PARTIES: BLM - FO and WO, Director BLM (with approval by Secretary)

INPUT GROUPS: BLM (USGS, FWS under 2974) FO & WO 722, 732

AVAILABLE DOCUMENTATION: Resource Reports from Federal and State agencies

### 3. Tentative Tract Selection

OBJECTIVES: To select a set of tracts for intensive environmental analysis  
to determine each tract's appropriateness for lease offering  
To provide to the Secretary and the public a preliminary list  
of tracts to be considered for leasing  
To begin preparation of development scenarios

CONTENT/FORMAT: List of tracts identified by block number on Protraction  
Diagram, acreage, average water depth and distance from shore,  
preliminary stipulations (if any).

TIMING: At least 60 days after Call for Nominations

MANDATE: 43CFR, part 3300, subpart 3301.4

PRIMARY BASES: Nomination patterns, negative nominations, socioeconomic and  
environmental information from Federal, State and local agencies,  
identifications of unique areas, preliminary risk assessment and  
pollutant trajectory analysis, major resource use conflicts,  
special interest by BLM or USGS (e.g., tracts previously offered  
or tracts in danger of drainage).

ASSOCIATED DECISIONS: Policy decision on approximate size of lease offering;  
resource use conflicts that appear unmitigatable; preliminary  
tract evaluations and possible revenues; method of bidding  
(royalty v. bonus)

RESPONSIBLE PARTIES: BLM and USGS in field recommend to BLM/USGS in Washington;  
mutual list agreed on and submitted to Secretary through Director,  
BLM.

INPUT GROUPS: BLM, USGS, States, local governments, private parties, industry,  
FWS, other Federal agencies.

AVAILABLE DOCUMENTATION: Nomination pattern without names of companies;  
set of negative nominations and recommended stipulations.

#### 4. Preparation of ES

OBJECTIVES: To describe existing environmental conditions  
To predict short and long-term impacts of the proposed lease  
sale on human, marine, and coastal environments  
To identify possible ways of mitigating adverse impacts  
To present alternatives to the proposed action  
To allow public review of proposed action

CONTENT/FORMAT: Generally a large document with complete descriptive, predictive  
and analytical information on physical, biological and socio-  
economic conditions and impacts. Specific regional issues should  
be thoroughly discussed. First full presentation and discussion  
of stipulations that might be imposed. Final ES addresses all  
comments.

TIMING: Begins with tract selection; draft ES approximately 4-5 months  
later; public hearings and comment period during subsequent  
2 months; final ES 3-4 months later

MANDATE: NEPA

PRIMARY BASES: All available environmental and socioeconomic information;  
development scenarios supplied by USGS; oil spill trajectory model;  
Harris/Seas socioeconomic models; previous sale ES's (if any);  
Federal, State, local, and public review comments on draft ES;  
possible transportation routes identified by TRAMP.

ASSOCIATED DECISIONS: Methods of mitigation (including stipulations and the  
tracts to which they would be applied), status of resolution of  
significant regional issues; Solicitor sign-off; Environmental  
Project Review sign-off.

RESPONSIBLE PARTIES: Both ES prep and hearing conducted by appropriate FO;  
 review by WO 732 and 712; Director, BLM; Solicitor; EPR; Secretary  
 sign-off; USGS and FWS under S.O. 2974; public hearings and written  
 review comments in final ES by Federal agencies, States, public.

AVAILABLE DOCUMENTATION: All included in ES except tract specific resource estimates  
 (which are never made public and need not be completed until just  
 before the lease sale).

Draft SID and preliminary Notice of Sale

OBJECTIVES: To provide Secretary and public with notification of possible  
 lease sale and the tentative bases on which the Secretary  
 will make his decision

To allow additional public review and comment on anticipated  
 Federal actions

CONTENT/FORMAT: SID format discussed in subsequent step; proposed Notice of  
 Sale identifies tracts proposed for offering; applicable  
 stipulations; criteria for bidders qualifications; format of  
 bidding and method.

TIMING: Approximately 60 days after final ES.

MANDATE: NEPA and Department policy

PRIMARY BASES: See subsequent step.

ASSOCIATED DECISIONS: See subsequent step.

RESPONSIBLE PARTIES: See subsequent step.

AVAILABLE DOCUMENTATION: Final ES and comments; SID

#### 6. Final SID

OBJECTIVES: To synopsize all factors related to proposed action  
 To present to Secretary alternatives to the action with  
 concomitant environmental and economic impacts  
 To present Secretary with regional issues, and their possible  
 resolutions

CONTENT/FORMAT: Executive summary format; presents significant environmental and socioeconomic information derived from ES; may present other economic, technological or political information not required in ES; all proposed stipulations and associated impacts included. Attached to ES

TIMING: At least 60 days after proposed Notice of Sale

MANDATE: NEPA

PRIMARY BASES: Final ES; proprietary resource evaluations from USGS; additional information supplied or acquired since final ES and resulting from proposed Notice of Sale; DOE coordination

ASSOCIATED DECISIONS: Desired size of lease offering; political considerations; evaluation of ability to mitigate adverse impacts and resource use conflicts

RESPONSIBLE PARTIES: WO 712 in consultation with POCS prepare draft; reviewed through BLM and USGS; recommended course made by Director, BLM.

AVAILABLE DOCUMENTATION: Comments from review of draft SID and draft Notice Final Tract Selection

OBJECTIVE: To compile the list of tracts that will be offered and the stipulations that will be imposed on each

CONTENT/FORMAT: List of tracts identified by block number, water depth, location, distance from shore; stipulations and the blocks to which they will be applied (general and specific)

TIMING: After SID and before Notice of Sale

MANDATE: Departmental policy

PRIMARY BASES: SID and final ES; newly acquired information

ASSOCIATED DECISIONS: Scheduling of Notice of Sale and Sale date

AVAILABLE DOCUMENTATION: None

RESPONSIBLE PARTIES: OCS FO and WO 722; Solicitor; Director, BLM

8. Notice of Sale

OBJECTIVE: To provide to all interested parties notification of lease sale and date, tracts being offered, bidding factors, lease terms (including applicable stipulations)

TIMING: At least 30 days before proposed sale date

MANDATE: OCS Lands Act; regulations 43CFR; 3301.5

PRIMARY BASES: Final tract list; applicable stipulations; resource evaluation

ASSOCIATED DECISIONS: Royalty v. bonus bidding determinations

AVAILABLE DOCUMENTATION: None

RESPONSIBLE PARTIES: OCS FO and WO 722; Solicitor; Director, BLM

9. Sale - Leases Issued

OBJECTIVE: To conduct competitive bidding (sealed bids)

10. Exploration Plan Evaluation and Drilling Permit Approval

OBJECTIVE: To provide for effective and environmentally sound exploration for oil and gas on the OCS

To monitor anticipated exploration activities

CONTENT/FORMAT: Plan is a technical document submitted by operator indicating, among other things; specific tract and approximate location(s) to be drilled on tract; type of rig to be used; depth to be drilled; mud program; desired time of drilling; high resolution seismic data coverage of tract; reservoir maintenance program; results of any required environmental surveys

TIMING: May be submitted any time up until final 90 days of five year lease term. Approval may take 2-3 months

MANDATE: Operating regulations

PRIMARY BASES: Bases for approval are generally compliance checks with sound practices and administrative requirements. These include compliance



with applicable Operating Orders and regulations, stipulations on the tract, proof of NPDES permit from EPA, CZMA, rig verification program (when completed)

ASSOCIATED DECISIONS: Inspection scheduling

RESPONSIBLE PARTIES: Industry, USGS Conservation Division, BLM, FWS, NPS, HCRS, States, EPA, USCG

AVAILABLE DOCUMENTATION: Operating Orders, stipulations and Notices to Lessees and Operators, if any

# 11. Transportation Management Plan Approval

OBJECTIVES: To facilitate orderly and timely development of hydrocarbon resources on the OCS to meet the Nation's energy needs  
To protect environmental resources on the OCS and in coastal areas  
To establish a process for early and continued cooperative planning to meet management information needs of affected decisionmaking bodies in the region

CONTENT/FORMAT: Analysis and recommendations for discrete pipeline corridors and alternatives; identification of sound alternative areas for the location of onshore facilities; alternatives regarding surface vessel transportation (coordinated with appropriate regulatory agencies); plans for monitoring construction and operations and follow-up studies that may be required; stipulations and use requirements applicable to rights-of-way.

TIMING: Planning process begins with Call for Nominations; final approval targeted for before development plan submission

MANDATE: Departmental policy; program not yet implemented

PRIMARY BASES: Results from regional and site-specific management studies; results from socioeconomic studies conducted by States; hazards assessments; spill trajectory modeling; ES on sale

ASSOCIATED DECISION: Regional Management Studies Plan, Site-Specific

Management Studies Plan; funding sources and procurement of studies; quality, availability, utility of existing information; other agency responsibilities (besides BLM and affected States); composition and tasks of working groups

RESPONSIBLE PARTIES: Primarily BLM and potentially affected State(s); all Federal agencies with jurisdictional or regulatory responsibilities for OCS operations; industry; local regulatory groups; public and special interest groups.

AVAILABLE DOCUMENTATION: Regional and site-specific plans and studies results; refined development scenarios; refined spill trajectory models (applied); approved coastal zone management plans

Development and Production Plan Evaluation and Approval

OBJECTIVES: To provide for effective and environmentally sound development and transportation to market of OCS oil and gas  
To provide advance notice of need for offshore and onshore production and transmission facilities

CONTENT/FORMAT: Development/production plans are again highly technical documents that describe the company's proposed method of producing and delivering hydrocarbons from a field. Of particular importance are the results from exploration activity (which serve to define reservoir size and producibility), additional geological and geophysical information, type of hydrocarbon (oil, gas, condensate), well development and maintenance programs, estimates of maximum efficient rate of production to maintain the reservoir, preferred method of transport to shore and landing points, and required onshore facilities.

TIMING: 1½ to 8 years after producible discovery

MANDATE: 30 CFR, part 250.34

PRIMARY BASES: Bases for approval, as for exploration plans, are generally compliance and consistency checks on sound practices and administrative requirements. These include compliance of the proposed field development plan with Operating Regulations and Orders; stipulations on the lease, inclusion of certain permit approvals (EPA for pollutant discharges, Corps of Engineers for placement of mobile or permanent structures, State and local approvals for development staging areas, USGS permit to install platform) and consistency with other State and local regulatory requirements, including approved coastal zone management plans. Of particular importance here is consistency with an approved regional Transportation Management Plan (TMP) for that portion of the development plan that relates to transportation of product. Development of the TMP involves coordination, studies, and planning by all the involved State, local and Federal agencies, as well as industry, that have responsibilities in OCS activities. The planning program being developed by BLM will streamline development plan preparation, allow for more integrated review and approval, and provide significant information to any EAR or ES that might be required on the development plan.

ASSOCIATED DECISIONS: Need for an ES on development plan (current Secretary) has committed Department to prepare at least one in each frontier area); actions on all permits to be included in plan; development scenario; EAR; USGS permit to install platform

RESPONSIBLE PARTIES: Industry submits plan; prior action by Corps, USGS (with BLM, NPS, FWS) for permit to install platform and EAR; States and

local agencies for permits for development staging areas;

Area Supervisor (USGS) approves development plan

DOCUMENTATION: Geological/geophysical information well logs from exploratory drilling program (proprietary); approved State coastal zone management plan(s); Transportation Management Plan for region, which includes results of regional and site-specific studies; Corps permit; USGS permit to install platform

#### Pipeline Permit Issuance

OBJECTIVES: To provide for environmentally safe and sound transport of oil and gas from the OCS

CONTENT/FORMAT: No specified format; must state purpose, material to be transported, size of pipeline, total distance and width of right-of-way proposed, accurate locations of initial and terminal points, and a 1:160,000 map showing accurately located center line of right-of-way proposed

TIMING: Sometime after production wells drilled; all permits issued within 10-30 days (API estimate), contingent on archeological survey; five years in which to construct

MANDATE: OCS Lands Act - 67 Stat.464, Sec.5(c)

PRIMARY BASES: Approved development plan; approved Transportation Management Plan (for BLM right-of-way approval); regional and site-specific studies and available information on resource use conflicts, hazards, and severity of impacts; oil spill trajectory analyses; development ES (if any).

RESPONSIBLE PARTIES: USGS, BLM, FWS, COE, USCG, FCC, ICC, MTB, State and local regulatory bodies. None of the Federal agencies is required to be the last approving agency. State and local permits come after Federal.

DOCUMENTATION: As in previous step plus any new information.

#### 14. Lease Termination or Expiration

OBJECTIVE: To assure diligent exploration, and development of tracts with marketable reserves of hydrocarbons

To provide for orderly development of resources

CONTENT/FORMAT: Notification by Secretary in writing; voluntary relinquishment by lessee in writing

TIMING: Any time during lease term

MANDATE: OCS Lands Act

PRIMARY BASES: Several different conditions can result in termination or cancellation. The primary lease term is 5 years, renewable under terms whereby the lessee shows indications of marketable reserves or when in production. Lease term may not be renewed when there is unproductive testing by drilling, or lessee through inaction shows lack of diligence. Leases may be relinquished (terminated) voluntarily by the lessee, as in the case of unproductive exploratory drilling. Other conditions affecting lessee's ability to explore or produce (lack of capital, lack of equipment, etc.) would likely result in an assignment of lease to another lessee, rather than relinquishment. Leases may also be cancelled by the Secretary (subject to judicial review) if he feels there is evidence of non-diligence or non-compliance with applicable stipulations, Orders, or other lease terms.

ASSOCIATED DECISIONS: Economic producibility; adequate transportation capabilities; compliance monitoring

RESPONSIBLE PARTIES: Primarily USGS Conservation Division

AVAILABLE DOCUMENTATION: Inspection reports, logs, G&G data.

APPENDIX B

Minutes of Coordination Meetings for Northern California  
Regional Studies Plan in 1978

UNITED STATES GOVERNMENT

## memorandum

DATE: MAY 24 1978

1740 NC - 1740 SC

REPLY TO: Dick Wilhelmsen, Oceanographer  
ATTN OF:SUBJECT: Summary of Preliminary Meeting with the State of California Concerning  
BLM's Regional Environmental Study Plans for Southern and Northern  
California  
TO: File

Don Keene, Jay Bassin, and Dick Wilhelmsen of the Pacific OCS Office met with the following State representatives in Sacramento on May 8 at 1:00 p.m. at the State Lands Commission to discuss State-federal coordination for preparing BLM's regional study plans:

Jim Rote - Special consultant to California State Lands Commission on tanker traffic. Also, member of the BLM Director's ad hoc advisory group on OCS environmental studies.

Dwight Sanders - State Lands Commission, Sacramento

Bob Gaal - State Lands Commission, Long Beach

Allan Lind - Governor's Office of Planning and Research

Richard Grix - Governor's Office of Planning and Research

Carol Pillsbury and Mari Collins of the California Coastal Zone Commission were invited, but did not attend.

The meeting's objectives were:

1. To identify key BLM and State participants for preparing the regional study plans,
2. To set up a procedure for State - BLM coordination and involvement in preparing the plans,
3. To discuss local government, public, and scientific participation in preparing the plans,
4. To set up the first regional meeting for the study plans.

Jim Rote gave a brief history of BLM's Environmental Studies Program and his participation in the ad hoc Advisory Group. He mentioned the NAS report on BLM's Studies Program and the Jamison Resolution of the OCS Advisory Board as drivers for the Studies' Program re-evaluation. The new national program plan prepared by the ad hoc Advisory Group stresses critical decision steps in the federal leasing and development process that should generate management issues and questions for BLM environmental studies.



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OPTIONAL FORM NO. 10  
(REV. 7-76)  
GSA FPMR (41 CFR) 101-11.6  
5010-11.

Don Keene introduced Jay Bassin as the POCS office preparer of the Southern California Regional Environmental Studies Plan and Dick Wilhelmsen as the POCS office preparer of the Northern California Regional Environmental Studies Plan. Don stated the meeting's objectives and requested the State's help in setting up a mechanism for State and local government participation and review. Don mentioned the short time frame for BLM to prepare the plans: a preliminary draft is due in Washington by June 15 and a final version to Washington by July 15. The final version will be updated and reviewed at least annually.

Richard Grix asked if the BLM's current draft central and northern California Studies plan will be used as a starting point for the new regional plan. Keene replied that the new direction and emphasis of the study program would require a different format and approach. However, several of the same issues and broad study areas could be identified in the new regional plans.

Keene distributed the general table of contents for the regional plans as taken from the national program plan. Keene said that the new plans would focus on key potential conflicts with OCS development such as issues concerning commercial and sports fishing, social infrastructure, air and water quality, marine and coastal ecosystems, recreational use, and archeological and cultural resources.

Allan Lind suggested a State and local government steering committee for coordination and review. The key State organizations and agency heads for State OCS coordination as designated by Governor Brown are:

State Resources Agency - Claire Dedrick

State Lands Commission - Bill Northrop

Coastal Zone Commission - Mike Fisher

Office of Planning and Research - Bill Press

Designated representatives for the agency heads who would make up the proposed State OCS Regional Steering Committee would be:

Resources Agency - Richard Hammond, Deputy Director

State Lands - Dwight Sanders

Coastal Zone Commission - Mari Collins, who is taking over OCS coordination from Carol Pillsbury

OPR - Allan Lind

Dr. Jim Davis, the new State Geologist who was formerly on the OCS Environmental Studies Advisory Committee from New York, will also be of help.



Keene requested that local government coordination and comments be coordinated by the State and the steering committee. Jim Rote and Allan Lind said they will initiate State involvement and coordinate with local governments. Comments and issues from local governments will be directed to Allan Lind, as State OCS coordinator. Keene said BLM would involve the federal agencies including at a minimum: U.S. Geological Survey, Fish and Wildlife Service, National Park Service, Environmental Protection Agency and National Oceanic and Atmospheric Administration.

Keene said that State and federal representatives would be invited to the first regional meeting, which would be on May 19. Local government and other outside participation would be handled by the State. Allan Lind said that local governments were busy responding to the Call for Nominations for Sale 53 and might not have the time or manpower to consider both topics. However, it was mentioned that local government identification of areas of concern and issues for the call would be good information for the regional studies plans. Lind said he would send another memo to the local governments informing them of the current process and requesting their comments on issues for the regional studies plans.

Keene distributed POCS Office issues identified in a February 24 memo to Washington. He said these would be a starting point for the plan preparation.

Jim Rote is concerned about the timing of the northern California study plan. He feels that urgent issues for northern California include: bird and mammal distributions and rookeries, sensitive biological areas, and impacts on the California Sea Otter. Dick Wilhelmsen mentioned that the Winzler and Kelley Summary of Knowledge for Central and Northern California provided a good summary and inventory of bird and mammal rookeries and sensitive biological areas. These are displayed on maps and overlays.

We discussed how the scientific community should participate and be involved. Dick Wilhelmsen said he will send the State his coordination list for contracts in central and northern California and the POCS Office will suggest some scientists for the State to contact for their participation. Jay Bassin suggested that intensive scientific involvement will be needed after the critical issues are identified by federal-State-local participants. Jim Rote said the State will also be thinking about who to contact.

Richard Grix will send a letter to the four designated State agencies formally requesting their attendance at the May 19 meeting under the signature of Denny Green, Acting Director of OPR.

Don Keene said that the May 19 meeting would include:

- 1) Introduction of the key participants and the State steering committee.

- 2) A brief update of BLM's study program plan and evaluation.
- 3) A discussion of issues that should be considered for the regional study plans.

The meeting will probably be at the POCS in Los Angeles, but will depend on the participation of the State Steering Committee. All participants will be notified as soon as possible.

*Richard L. Withelosen*

UNITED STATES GOVERNMENT

## memorandum

DATE: MAY 26 1978

REPLY TO: Don Keene, Environmental Studies Staff Chief

1740

SUBJECT: Regional Studies Plan Coordination Meeting

TO: Manager, Pacific OCS Office

The first Regional Studies Plan Coordination Meeting was held in Los Angeles in Room 8544 of the Federal Building on May 19, 1978 at 1:00 p.m. The stated purpose of this conference was to present to state and other federal agencies the status of the revised environmental studies program, introduce the new Study Design for Resource Management Decisions Oil and Gas Development and the Marine Environment, identify the representatives of appropriate agencies, and to solicit issues for consideration in the Regional Studies Plans for Southern and Northern California.

The list of attendees to this meeting is appended (Attachment 1).

Dr. James Rote, Special Consultant to the State Lands Commission, advisor to the Director of BLM, and member of the Ad Hoc committee that prepared the National Plan, had been requested by the Director to represent the BLM insofar as the background and contents of the Plan were concerned. In this role, Dr. Rote mentioned the Director's personal commitment to the Studies Program, and discussed present funding levels. The critical difference between the old approach and the new, as Dr. Rote stressed, is that the new Plan uses the information needs of BLM Managers to "drive" studies. It is, therefore, designed around policy rather than the concept of baselines. He then distributed a schematic of the steps in the decision making process, a table showing present status of all pending lease sales, and a sample contents page for the new Regional Studies Plans (Attachment 2). He identified the six key use conflicts mentioned in the National Plan: fishing; recreation; onshore infrastructure; ecological relationships; air and water quality; and archaeological and historic resources. Rote concluded by pointing out that the first draft for each Regional Studies Plan is due by June 15, and a "final draft" is due a month later.

Don Keene then presented a brief summary of the Regional Studies Plan (RSP) organizations, based upon two key considerations: First, conflicts may arise between offshore oil and gas development and other potential uses of the OCS. Second, there are certain socially-acceptable levels of trade-offs in resolving these potential conflicts. The crux to the plan is therefore to identify these conflicts, relate them to management decision points, and then to suggest the types of information needed to address them. The RSPs incorporate seven key features:

1. Each portrays a mechanism, not a description of studies requirements.



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2. Each represents a draft, and will be periodically revised or updated.
3. Each attempts to describe and analyze the decision-making process.
4. Studies requirements are reached by an analysis of the issues.
5. The plans are realistic in terms of management concerns and funding potential, and do not seek a idealized level of effort.
6. The term "Environmental" incorporates sociological, economic, biological, and geological considerations.
7. Each plan recognizes information needs in the context of decisions, regardless of what agency has mandated responsibility for getting that information.

In the ensuing discussion, it was pointed out that local issues will certainly be addressed within the RSPs, and that the drafts will be circulated to state, local federal, and scientific advisory panels for review.

As a starting point, Keene presented the eight issues compeled by the Pacific OCS Office as significant in the decision-making process:

1. Air Quality.
2. Special Biological Areas off Southern California.
3. Special Biological Areas off Northern California.
4. Birds and Marine Mammals of Southern California.
5. Birds and Marine Mammals of Northern California.
6. Geologic Hazards of Northern California.
7. Nearshore and Onshore Impacts of Southern California.
8. Commercial and Sports Fishing off Northern California.

Peter Douglas, Deputy Commissioner of the California Coastal Zone Commission, stressed that the list should specifically address recreational impacts, shipping, safety conflicts, aesthetics (or visual impairments), and the compatibility between proposed Sales and California's Coastal Zone Plan.

James Slawson (NOAA/NMFS) emphasized that impacts from oil spills are a major concern. These include toxic effects, effects on fishing gear, boat coating, economic effects, and impacts on tourism. Dick Nitsos (CDFAG) added that for Northern California, conflicts with the trawler fisheries would be significant. Some conflicts would be space competition, gear tangling on wellheads and obstructions, and the fear of the decline of fishing as a way of life.

Jim Rote (State Lands) and Allan Lind (OPR) emphasized that shipping conflicts with OCS development along the entire West Coast is an issue that should be pointed out to the Secretary of Interior in the Regional Studies Plans. This issue includes safety factors, the possibility of changing shipping lanes, recreational boating conflicts, and conflicts with historical and natural shipping approaches.

Throughout the conference, attendees contributed points and questions. A summary of the major concerns follows:

James Slawson (NOAA/NMFS) wanted to know if the revised concept invalidates all studies undertaken previously. Dr. Rote pointed out that many studies already fall into the new framework, and that future studies will parallel the schedule of decision points. Slawson raised the concern that oil spills and related cleanup procedures should be covered in the plan. Rote admitted that spill cleanup are not covered in the national plan. (They are, however, considered in great detail in the National and Regional Oil Spill Contingency Plans presently administered by the U.S. Coast Guard) and that they should probably be discussed in the RSPs.

Dave Scholl (USGS, Menlo Park) requested clarification that the major concern of the Ad Hoc committee, expressed in terms of the effect of development upon the ecosystem, included the concept of the geological hazards and their possible effect upon development. Rote, speaking for the committee, agreed that the plan did include such concerns. Scholl then asked Keene for the basis by which various issues were ranked, referring to Air Quality as top priority. Keene responded by pointing out the ultimate test of court challenges, and that those issues which could delay or impede Sales were of obvious priority.

Rote addressed the State's concern that southern and northern California issues were ranked together, implying that perhaps northern California studies would not be initiated until all Southern California studies were funded. It was pointed out that ranking of issues is not the same as ranking of studies, and that a single issue could generate several studies. In any event, studies would be funded on the basis of when their results would be required for the decision process.

Several questions addressed the immediate needs for information, such as for tract selection for Sale 48, and the Transportation Management (Pipeline corridor) concept. Keene was not optimistic about new studies being funded and underway in time for tract selection (although he pointed out that much information is already available for this step from previous studies), but new research should be available in time for the Sale decision and for other critical steps after the sale.

Discussion centered around conflicts with fishermen (primarily space use) and shipping safety. BLM acknowledged the need for cumulative impact considerations, and pointed out that such factors are already evaluated.

Jim Rote said that the State OCS Advisory Group for developing these Regional Studies Plans would be as follows:

Allan Lind - OPR  
Peter Douglas - CCZC  
Jim Davis - State Resources Agency  
Dwight Sanders - State Lands Commission

Don Keene requested input from all attendees on the issues their respective organizations deem important. He informed the attendees that each would have an opportunity to review and comment on the draft plan between June 15 and June 30.

Enclosures

*Donald F. Keene*

ATTENDANCE LIST - REGIONAL STUDIES  
 PLANNING MEETING, LOS ANGELES  
 MAY 19, 1978

<u>Name</u>	<u>Address and Affiliation</u>	<u>Telephone</u>
N. Jay Bassin	Pacific OCS Office, BLM, 300 N. Los Angeles St. Los Angeles, CA 90012	(213) 688-7104 (FTS) 798-7104
John Lane	"	"
Don Keene	"	"
Richard Wilhelmsen	"	"
Steve Smith	Pacific OCS Office	7107
Mike Aceituno	Pacific OCS Office	"
Herb Emmrich	Pacific OCS Office	"
Ellen Aronson	Pacific OCS Office	7234
Harold Martin	Pacific OCS Office	"
Fred Sieber	BLM Washington, D.C.	(202) 343-7744
Jim Slawson	NOAA/NMFS	548-2518
Gene Nitta	NOAA/NMFS	
Richard Nitsos	California Dept. Fish & Game	(213) 590-5174
John Byrne	USFWS/Portland, OR	(503) 231-6154 (FTS) 429-6154
Robert Gaal	State Lands Commission	(213) 590-5201
Dwight E. Sanders	State Lands Commission-Sacto.	(916) 322-7827
Edward Sprotte	California Div. Mine & Geology 107 S. Broadway Room 1065 Los Angeles, CA 90012	(213) 620-3560
Perry Y. Amimoto	California Div. Mines & Geology Sacramento	(916) 445-5716
Fred J. Schambeck	U.S.G.S. Los Angeles, CA	(213) 688-2846 (FTS) 798-2846
Jim Rote	State Of California	(916) 445-1012
Peter Douglas	State of California Coastal Comm.	(415) 557-1001
Allan Lind	OPR - Sacramento	
David W. Scholl	Pacific-Arctic Branch, USGS, Menlo	(415) 323-2468 (FTS) 467-2468
Donald T. Krofsen	L.A. District Geologist's Office	(213) 688-5780

FIG 2. STEPS IN THE DECISIONMAKING PROCESS

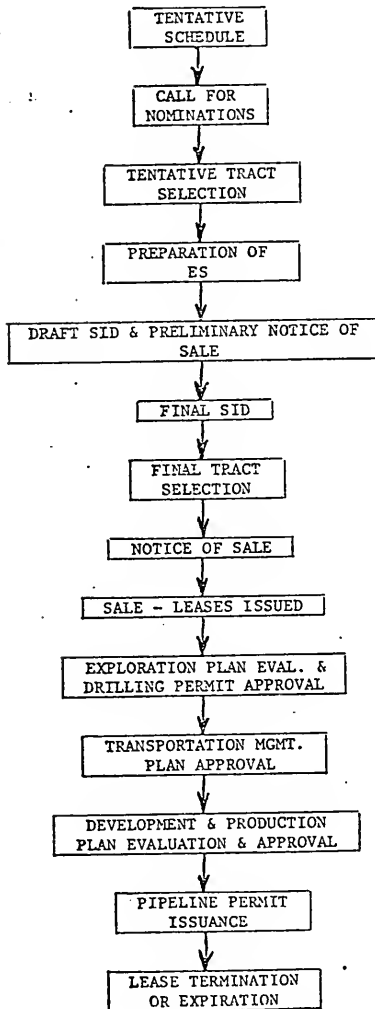




TABLE 1. OCS SCHEDULING TABLE.

Area	Number	Tentative Schedule (Date of Publication)	Call for Nominations	Tentative Tract Selection (Date of Policy Decision- Sale Size)	Draft Environmental Statement	Final Environmental Statement	Secretarial Issue Document (Date of Secretary's Decision Meeting)	Final Notice of Sale and Stipulations	Sale (Lease Award)	Exploration Plan Evaluation (Date of First Production Plan Approval)	Development and Production Plan Evaluation (Date of First Production Plan Approval)	Issuance of Pipeline Rights-of-Way	Termination of Lease
South Texas	37	11/74	12/73	5/74	8/74	11/74	4/75	1/75	2/75	6/75	8/77		
Central Gulf	38	11/74	12/74	10/74	12/74	2/75	4/75	4/75	5/75	6/75	3/76		
Central Gulf	38A	11/74	12/74	10/74	12/74	3/75	4/75	4/75	5/75	6/75			
So. California	35	11/74	2/74	8/74	2/75	8/75	10/75	10/75	12/75	6/76			
Gulf of Alaska	39	11/74	11/74	2/75	6/75	11/75	2/76	3/76	4/76	3/76			
Gulf of Mexico	40	11/74	12/74	3/75	8/75	12/75	1/76	1/76	2/76	3/76			
Mid-Atlantic	41	11/74	3/75	8/75	12/75	5/76	7/76	7/76	8/76	11/77			
Gulf of Mexico (Drainage)	44	11/74	NA	NA	6/76	9/76	10/76	10/76	11/76	1/77			
Gulf of Mexico (Deep)	47	11/74	3/76	7/76	11/76	2/77	3/77	3/77	4/77	6/77			
Cook Inlet	41	11/74	9/75	3/76	7/76	12/76	9/77	9/77	10/77	5/78			
North Atlantic	42	11/74	6/75	11/75	10/76	8/77	10/77	12/77	1/78				
So. Atlantic (Ca. Embayment)	43	11/74	9/75	4/76	2/77	10/77	12/77	2/78	3/78				
Gulf of Mexico	45	1/77	NA	1/77	4/77	11/77	1/78	3/78	4/78				
Eastern Gulf of Mexico	65	5/77	5/77	7/77	1/78	6/78	7/78	9/78	10/78				
Gulf of Mexico	51	1/77	2/77	6/77	2/78	7/78	9/78	11/78	12/78				
Mid-Atlantic	49	11/74	11/76	9/77	5/78	10/78	11/78	1/79	2/79				
So. California	48	11/74	7/76	1/77	8/78	1/79	3/79	5/79	6/79				
Gulf of Mexico	58	1/77	10/77	2/78	9/78	2/79	4/79	6/79	7/79				
So. Atlantic (Blake Plateau)	54	11/74	9/77	4/78	1/79	6/79	8/79	10/79	11/79				
Xodak	46	11/74	10/75	4/76	12/75	5/80	7/80	9/80	10/80				
Cent. and No. California	53	8/77	11/77	9/78	4/80	9/80	11/80	1/81	2/81				
Federal/State Beaufort Sea	55	1/77	2/78	4/78	3/79	8/79	9/79	11/79	12/79				
Gulf of Alaska	62	1/77	5/78	10/78	8/79	1/80	3/80	5/80	6/80				
Gulf of Mexico	52	11/74	9/78	2/79	10/79	3/80	5/80	7/80	8/80				
North Atlantic	60	1/77	11/78	4/79	12/79	6/80	8/80	10/80	11/80				
Cook Inlet	60	1/77	12/78	5/79	2/80	10/80	12/80	2/81	3/81				
So. Atlantic (Ca. Embayment)	56	1/77	3/79	9/79	6/80	11/80	8/79	3/81	4/81				
Mid-Atlantic	59	1/77	9/79	2/80	10/80	3/81	5/81	7/81	8/81				
Gulf of Mexico	66	8/77	11/79	4/80	11/80	4/81	6/81	8/81	9/81				
Bering-Norton	57	1/77	4/79	2/80	12/80	7/81	9/81	11/81	12/81				

\*Sale Enjoined.

S= Substitute or modified sale.

TABLE 2. SALES DROPPED FROM PROPOSED OR PLANNED SCHEDULE AND SALES MODIFIED AND RESCHEDULED

Area	Number	Tentative Schedule (Date of Schedule)	Schedule Sale Date	Date of Schedule Modifying or Dropping Sale	Result
Bering Sea (St. George)	45	11/74	10/76	1/77	Dropped
Beaufort Sea	50	11/74	9/77	1/77	Modified
Outer Bristol Basin	51	11/74	10/77	1/77	Dropped
So. California (Deep)	53	11/74	2/78	6/75	Dropped
Gulf of Alaska (Aleutian Shelf)	56	11/74	9/70	1/77	Dropped
No. Calif., Wash., & Oregon	57	11/74	10/78	8/77	Modified
Chukchi Sea (Hope Basin)	58	11/74	12/78	1/77	Dropped
					(Gulf of Mexico Substituted)
					(To State/Federal)
					(Gulf of Mexico Substituted)
					(Cent. & No. California Substituted)
					(South Atlantic, Ga. Embayment Substituted)
					(To Sale #53, Cent. & No. California)

-SAMPLE CONTENTS FOR A REGIONAL  
ENVIRONMENTAL STUDIES PLAN

**SYNOPSIS:**

Synopsis of this document, Study Design for Resource Management Decisions

**CHAPTER 1. INTRODUCTION**

Purpose, goals, and approach of this regional plan

**CHAPTER 2. STATUS AND FUTURE SCHEDULING**

Description of the OCS related development that has taken place in the region

Scheduled decisions that could result in further development

**CHAPTER 3. ISSUES AND IMPACTS**

Of the potential activities which are likely to be important because of the impacts associated with them?

What do the basic management questions indicate about these region specific issues?

**CHAPTER 4. SCIENTIFIC ASSESSMENTS**

How have the issues identified been treated in past work?

What alternative analytical approaches are there for resolving them in the future?

**CHAPTER 5. CANDIDATE STUDY AREAS**

(1) Studies for which sufficient information exists  
How long will it take to assemble the information in a useful format; will it be timely? How much will it cost?

(2) Studies for which information does not appear to exist.  
What information needs to be developed?  
What seems to be the best system for developing it?  
How long will it take, will it be timely?  
How much will it cost?

**CHAPTER 6. SCHEDULING OF RESULTS**

Reporting requirements and dissemination of results

APPENDIX C

1976-77 Coordination Meetings for Preliminary Draft Marine  
Environmental Study Plan Prepared in 1977

Environmental Studies Coordination Meetings for  
Central and Northern California Marine Environmental Studies Plan

Representation

December 7, 1976	Monterey, Ca.	California Department of Fish and Game Pacific Environmental Group, NOAA Sea Grant Marine Advisory Repre- sentative
	Moss Landing, Ca.	Faculty and Staff of Moss Landing Marine Lab Association of Monterey Bay Area Governments
December 8, 1976	Tiburon, Ca.	Staff of Tiburon Lab, National Marine Fisheries Service, NOAA San Francisco State University College of Marin Point Reyes Bird Observatory California Academy of Sciences Sea Grant Marine Advisory Repre- sentative
	Berkeley, Ca.	Faculty and Staff of Lawrence Berkeley Laboratory, University of California, Berkeley Bodega Marine Lab
December 9, 1976	Bodega Bay, Ca.	Faculty and Staff of Bodega Marine Lab
	Dillon Beach, Ca.	Faculty of Pacific Marine Station, University of the Pacific
December 10, 1976	Arcata, Ca.	Faculty of Humboldt State University U.S. Fish and Wildlife Service Sea Grant Coordinator California Department of Fish and Game
January 6, 1977	Los Angeles, Ca.	U. S. Geological Survey
January 11, 1977	Sacramento, Ca.	California State Lands Commission
	Sacramento, Ca.	California State Resources Agency

APPENDIX D

BLM Studies Products Currently Available for the West Coast

PROCEEDINGS/LITERATURE SURVEYS/REPORTS  
 Pacific OCS Office  
 Bureau of Land Management  
 Los Angeles, California

1. "Proceedings - Recommendation for Baseline Research in Southern California Relative to Offshore Resource Development"

Available - Pacific OCS Office  
 Price - \$4.00

2. "Proceedings - Recommendation for Baseline Research in Central and Northern California Relative to Offshore Resource Development"

Available - Pacific OCS Office  
 Price - \$4.00

3. "Proceedings - Recommendation for Baseline Research in Oregon and Washington Relative to Offshore Resource Development"

Available - Pacific OCS Office  
 Price - \$4.00

4. "Preliminary Report on the Environmental Geology of Selected Areas of the Southern California Continental Borderland" Open File Report No. 75-596. Available from the U.S. Geological Survey, Public Inquiries Office, Menlo Park, California 94025.

5. "Summary of Knowledge of the Southern California Coastal Zone and Offshore Areas" (Literature Survey - 3 Vols.)

Available - Pacific OCS Office  
 Price - \$12.50

6. "Summary of Knowledge of the Central and Northern California Coastal Zone and Offshore Areas" (Literature Survey - 8 Vols. est.)

Available - NTIS  
 Price - Vol. I Physical Description - \$13.25  
 (Accession No. PB274210/AS)  
 Vol. II Physical Description - \$15.00  
 (Accession No. PB274211/AS)  
 Vol. III Biological Description - \$15.50  
 (Accession No. PB274212/AS)  
 Vol. IV Biological Description - \$14.00  
 (Accession No. PB274213/AS)  
 Vol. V Biological Description - \$16.50  
 (Accession No. PB274214/AS)  
 Vol. VI Socio-Economic Considerations - \$19.00  
 (Accession No. PB274215/AS)  
 Vol. VII Socio-Economic Considerations - \$15.25  
 (Accession No. PB274216/AS)  
 Vol. VIII Master Bibliography - \$21.50  
 (Accession No. PB274217/AS)

(Order for all 8 volumes - PB274209/AS: \$120.00  
 Also available from NTIS on Microfiche at \$3.00  
 per volume)

7. "Summary of Knowledge of the Oregon and Washington Coastal  
 Zone and Offshore Areas" (Literature Survey - 3 Vols. est.)

Available - NTIS  
 Price - Vol. I Physical Description - \$19.00  
 (Accession No. PB272490/AS) -  
 Vol. II Biological Description - \$19.00  
 (Accession No. PB272491/AS)  
 Vol. III Socio-Economic Considerations and  
 master Bibliography - \$24.00  
 (Accession No. PB272492/AS)  
 (Order for all three volumes - (Accession  
 No. PB272489/AS: \$62.00)

8. "Air Quality Analysis Study - Southern California Bight"  
 (1 Vol.)

Available - NTIS  
 Price - \$14.50 (hard copy)  
 3.00 (Microfiche)  
 Accession No. PB279088/AS



9. "Final Report: First Year Southern California Baseline Studies and Analysis" (3 Vols.)

Available - September '78 from NTIS  
Price - To be determined

10. "Final Report: First Year Marine Mammals and Seabirds Study, Southern California" (3 Vols.)

Available - August '78 from NTIS  
Price - To be determined

11. "Archeological Literature Survey and Sensitivity Zone Mapping of the Southern California Area"

Available - November '78 from NTIS  
Price - To be determined

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NTIS - National Technical Information Service  
Operations Center  
5285 Port Royal Road  
Springfield, VA 22161

Paper Copies

U.S. Geological Survey  
Attn: Librarian  
345 Middlefield Road  
Menlo Park, CA 94025

U.S. Fish & Wildlife Service  
Attn: Dr. Jay Watson  
P.O. Box 3737  
Portland, Oregon 97208

U.S. National Park Service  
Attn: Dr. Milton Kolipinski  
450 Golden State Avenue  
San Francisco, CA 94102

National Oceanic & Atmospheric  
Admin.  
Attn: Dave Mackett  
P.O. Box 271  
La Jolla, CA 92038

Bureau of Land Management  
Attn: Chief, Environmental  
Coordination Section  
2800 Cottage Way, Rm. E-2841  
Sacramento, CA 95825

California Coastal Zone Commission  
Attn: Carol Pillsbury  
1540 Market Street  
San Francisco, CA 94102

State Clearinghouse  
Governor's Office of Planning  
and Research  
Attn: Alan Lind  
1400 10th Street  
Sacramento, CA 95814

Microfiche Copies

Department of Fish & Game  
Attn: John L. Baxter  
411 Burgess Drive  
Menlo Park, CA 94025

NOAA  
National Marine Fisheries Service  
Attn: Clifford Fiscus  
7600 Sand Point Way, N.E.  
Seattle, WA 98115

Southern California Coastal  
Water Research Project  
Attn: Willard Bascom  
1500 E. Imperial Highway  
El Segunco, CA 90245

Association of Monterey Bay  
Area Governments  
Attn: Wilber F. Smith, Ex.  
Box 190  
Monterey, CA 93940

Association of Bay Area Gov.  
Attn: A-95 Clearinghouse  
Hotel Claremont  
Berkeley, CA 94705

San Diego County Comprehensive  
Planning Organization  
Security Pacific Plaza  
1200 Third Avenue  
San Diego, CA 92101

Santa Barbara County - Cities  
Area Planning Council  
1306 Santa Barbara Street  
Santa Barbara, CA 93101

Southern California Association  
of Governments  
Suite 100  
600 South Commonwealth Avenue  
Los Angeles, CA 90005

Mr. WOLFE. I would like to conclude my statement by saying that if our national priority is to expand domestic production of petroleum, even given the figures on conservation I have submitted, I would submit again that it is necessary that if this is going to be a priority for the President, for the Congress, and for the people of this country, then we should darned well be willing to pay for the adequate assessment of the environmental costs or we should not proceed.

Short-term benefits must not become trade-offs for major long-term environmental costs. The urgency in the proposed leasing schedule must be tempered with the wisdom of caution and care. And I would say that in war as in peace, it is those who distinguish themselves are those who maintain a cool and responsible mentality and a level of action.

I can only say that in looking at the coastline of which I am familiar, and I have driven the coastlines from Maine to Florida, and from Washington to south of Mexico, our coast is indeed one of the most beautiful I have ever seen, with due respect to the coast of New Jersey, and so forth.

Mr. HUGHES. I might add that we also prize our beautiful sandy beaches and waters. We value them just like you do here in California, believe me.

Mr. WOLFE. Thank you.

Mr. HUGHES. But you do have magnificent country. We are pleased to be here.

Mr. WOLFE. Thank you. We are honored you are. I would just say in certain times and in certain regards, there are some possessions which we all have, some national treasures, I would suggest, which have no price tag on them. There are some things we would not sell for any reason. And I would suggest that beauty is one of those, natural beauty is one of those. The northern and central California coast is one of those.

I can only harken to the words of Teddy Roosevelt as he looked out at the Grand Canyon many years ago, and I think in regard to OCS development on this coast his words rung true when he said, "The waters and the wind have carved it, the ages have preserved it, and man would only mar it. Let it be." Thank you.

Mr. HUGHES. Thank you, Mr. Wolff.

[Mr. Wolfe submitted the following on behalf of the League of Women voters of Marin County.]

[The material follows:]

The "Analyses of Aromatic Hydrocarbons in Intertidal Sediments Resulting from Two Spills of No. 2 Fuel Oil in Buzzards Bay, Massachusetts," by John M. Teal, Kathryn Burns and John Farrington; The "Photosynthesis and Fish Production: Hypothetical effects of Climatic Change and Pollution," by W. Greve and T. R. Parsons; The "Effects of Oil on Marine Ecosystems: A Review for Administrators and Policy Makers," by Dale R. Evans and Stanley D. Rice; accompanying the Testimony of Mr. Wolff could not be printed due to the poor state of the submitted copies and are on file in the official Committee hearing files.]

LEAGUE OF WOMEN VOTERS OF MARIN COUNTY,  
San Rafael, Calif., August 30, 1979.

COMMITTEE ON THE OUTER CONTINENTAL SHELF  
House of Representatives, Longworth House Office Building, Washington, D.C.

HONORABLE COMMITTEE MEMBERS: The League of Women Voters was gratified by the passage of the bill introduced by Congressman Burton exempting the area within 15 miles of the Point Reyes National Seashore from oil and gas drilling. We

also supported the preparation of an E.I.S. on Marine Sanctuary status for the Point Reyes and Farallon Island region. We feel that this unique region, which belongs to all the citizens of this country, ought to be preserved. However we realize Congressman Burton's bill preserving the area within 15 miles of the coast would not give adequate protection if drilling is permitted in the area specified in O.C.S. 53. The Point Reyes National Seashore and the Golden Gate National Recreation Area are down wind from the area specified in this lease. The prevailing wind and water surface action would move any oil or air pollution resulting from drilling in this area into the Point Reyes National Seashore with its irreplaceable natural resources. Since the oil will be transported by barges rather than Pipelines, it will increase air pollution downwind.

Although we recognize the national need for additional oil and gas, we question whether the projected amount of fuel that can be extracted from these tracts is worth the potential environmental damage to this publicly owned resource. It is our understanding that the U.S.G.S. estimates that there will be only a potential total production of 8 million barrels of oil and 8 billion cubic feet of natural gas from these eight tracts. In terms of our current consumption of oil that is only enough to supply this country for ten hours. We hope you will weight these figures as you make your decision.

Respectfully,

BARBARA FUCHS,  
*President.*

BETH SHORE,  
*State Program Directors.*

COASTAL ALLIANCE II,  
*Sacramento, Calif., Thursday, August 30, 1979.*

HOUSE SELECT COMMITTEE ON THE OUTER CONTINENTAL SHELF,  
*Point Reyes Station, Calif.*

HONORABLE CONGRESSMEN: The Northern Chapters of Coastal Alliance II urge you to delay action on Lease Sale #53 based on the uniqueness of the resource and the paucity of information for much of the area.

The Coastal Alliance is an assemblage of individuals and organizations throughout California which have organized in order to achieve adequate protection of the irreplaceable resources along the California Coast. This organization placed Proposition 20, the Coastal Initiative, on the ballot in 1972 after the California legislature failed repeatedly to pass any protective legislation. As you probably know, Proposition 20 passed with the largest percentage of votes, 55%, of any initiative to date. The Coastal Alliance has recently been reactivated to assist in fending off the vast number of special interest groups that influence much of Sacramento's legislation, and to assist in the development of Local Coastal Programs called for in the 1976 Coastal Act.

The Alliance is in opposition to the rapid execution of Lease Sale #53 because of the special nature of the Northern California coast. At a BLM sponsored gathering of the scientific community in San Francisco in 1976, there was a great deal of testimony from scientific stating that many areas in Northern California had never been visited by scientists because of the difficulty of access and the small numbers of scientists in the area. In the literature search type of studies undertaken so far by BLM, the nature and abundance of resources are not accurately portrayed since there have been so few studies. This area is indeed vastly wealthy but simply not catalogued to date. The Northern California coastal area, is, in fact, a national resource, deserving of the kind of data gathering studies that take considerable time and money.

At the same meetings, the scientists described other areas where there was a significant lack of knowledge such as information about the migratory paths of elephant seals, whales and other marine mammals, of anadromous fish and of migratory birds in the Pacific Flyway. Still less is known of the impact of oil on these animals, particularly in regard to their breeding cycles. Other unknowns essential to the understanding of the marine fauna are the drift and current patterns in Northern California waters. To locate the leases without any of this kind of information and without acting in full partnership with the scientific community would be to willingly and willfully plunder the resources of the California coast.

Tomales Bay, where you are today, offers an example of a unique coastal resource which should never be subjected to the threat of an oil spill. The bay is the most pristine along the California coast with an important expanding mariculture industry. It provides harbor to thousands of migrating waterfowl and shorebirds on the

great Pacific Flyway in the fall, winter and spring months. These birds depend on rich ell grass beds and a large invertebrate population of Tomales Bay.

The bay does not flush well because of its long, narrow faultline conformation and the reduced inflow at the south end from past water damming projects. Oil entering this bay would have devastating effects on food supplies, wildlife, beaches, etc.

Because of the special nature of the California Coastal Resource and the lack of information about these resources, the California Coastal Alliance urges this Committee to dealy the sale of Lease Sale #53 and insure that productive, comprehensive scientific studies are undertaken, not rehashings of inadequate information.

Respectively submitted.

PHYLLIS FABER,  
*Board of Directors.*

SUSAN MCCABE,  
*Executive Director.*

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JOEL W. HEDGPETH,  
ENVIRONMENTAL AND EDITORIAL ANALYSIS,  
*Santa Rosa, Calif., August 30, 1979.*

HOUSE SELECT COMMITTEE ON THE OUTER CONTINENTAL SHELF,  
*Point Reyes, Calif.*

GENTLEMEN: Inasmuch as the stated purpose of your hearings of August 29 and 30 is "to determine whether local input is being considered by the Department of the Interior," it is unfortunate that there is no scheduled testimony on the part of mariculture and scientific interests. The University of California maintains a multi-million dollar research establishment on Bodega Head, involving extensive experimental work on the culture of marine organisms as part of its Sea Grant Program. Bodega Head lies within the danger zone of oil exploration and drilling activity as designated on the BLM due west of Bodega Head. Yet this has been overlooked in the preparation of a witness list for this hearing. Nevertheless I believe the committee will in time be advised of the University's concern in this matter.

It is stated in the agenda that "the federally owned Point Reyes National Seashore is protected for a 15-mile radius by the 1978 OCS Act Amendments." The general map publicly distributed by the BLM showing the tracts involved in the OCS 53 lease proceedings has the first scale in nautical miles, the second in kilometers and the last scale in statute miles. It appears from this map that 15 mile nautical mile radius from Tomales Point would include several of the tracts off Bodega Head. This is too close in any event for the safety of the investment in money and research time at Bodega Head, for any consequential oil spill or blowout 11 miles or so west of Bodega Head would reach the shore and also be accumulated in Bodega Harbor and Tomales Bay. Oil spills in these small bays could last there for years and seriously damage the environment.

There are a number of recurring natural phenomena that clearly indicate the trajectory of near shore currents along the Marin and Sonoma county coast. Almost every spring masses of the blue jellyfish like organisms, which lives out in mid ocean, drift ashore with the wind and pile up on the beach in windrows. This tells us that floating objects even in mid ocean frequently reach the shore. The mineral composition of the sandy beaches, especially in Tomales Bay and the great 14 miles beach north of Point Reyes indicates that much of this sand originates in the Russian River drainage.

We have three current regimes on this coast. In late spring and summer the Upwelling Season, driven by strong winds from the northwest, produces a strong near shore flow southward with colder subsurface water coming up at the shore from several hundred feet. Release of oil in this environment at this time would flow southward toward San Francisco and Monterey, and would endanger fishery productivity that depends on the upwelling water.

The second period, referred to as the Oceanic Season is characterized by southward flowing currents, but with eddies and some northward currents near shore. At this time drifting material may be moved into Tomales Bay or circle around in some of the eddies for a while before reaching shore.

In winter we have the Davidson Current season, of predominantly northward flowing water near shore, but again with near shore eddies. During this season drift bottles and larval stages of many invertebrates are moved northward, often within a few weeks. Bottles released off Bodega Head have been recovered on the Oregon Coast, for example.

In all these systems, which of course vary in force and persistence from year to year depending on storms, etc., there is some southward component. See the attached diagrams, based in part on Satellite and U-2 photographs. What they tell us is that any considerable oil spill at least as far north as Point Arena, can contaminate the Bodega Marine Laboratory, Tomales Bay and the Point Reyes National Seashore at least 8 months of the year. Any event like the current one off Yucatan would affect the entire California coast or drift north to Oregon, certainly if it is within a dozen miles of the shore, probably under strong onshore wind conditions, much further out.

Bearing in mind the seismically active nature of this coast, one can ask if the anticipated yields from the leases are worth the very considerable risk.

Very truly yours,

JOEL W. HEDGPETH.

Attachments.



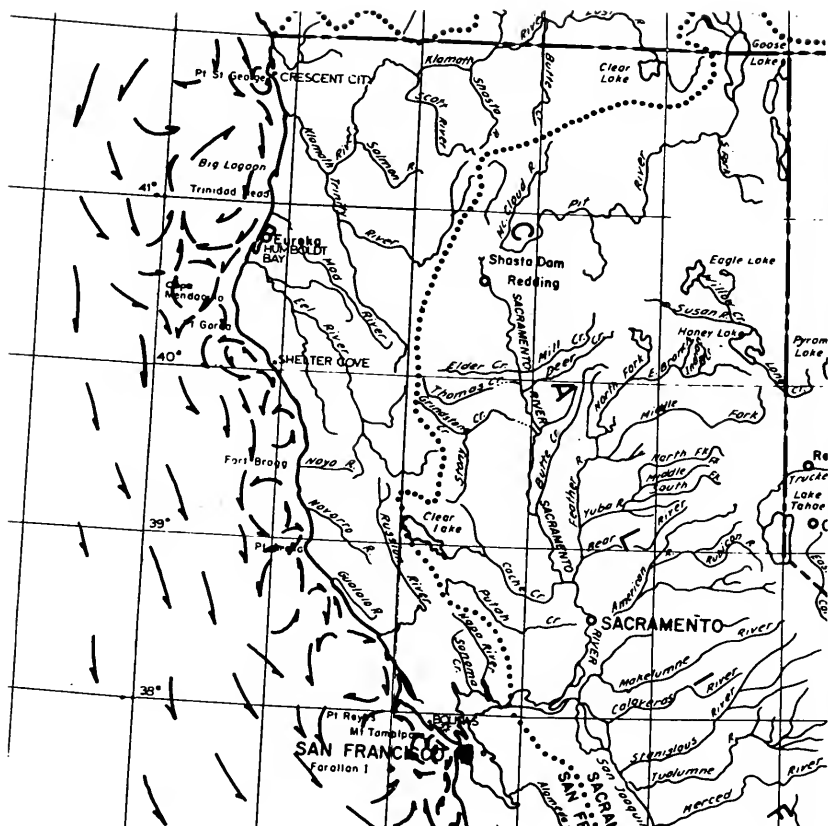


Figure 1-5. Generalized Northern California surface currents for the Oceanic Season.

(July - November)



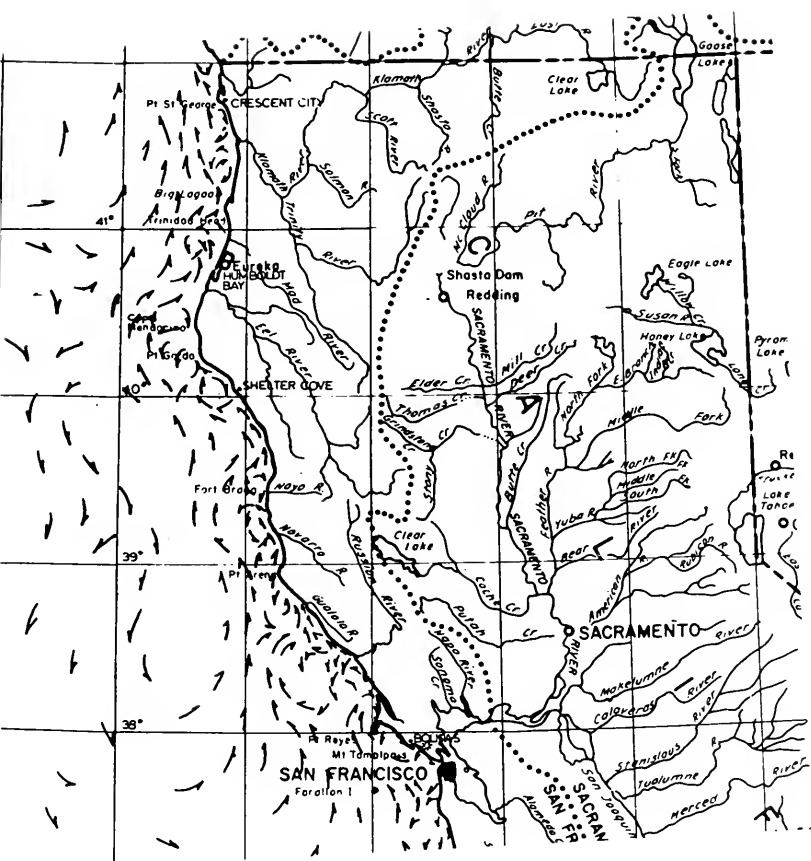
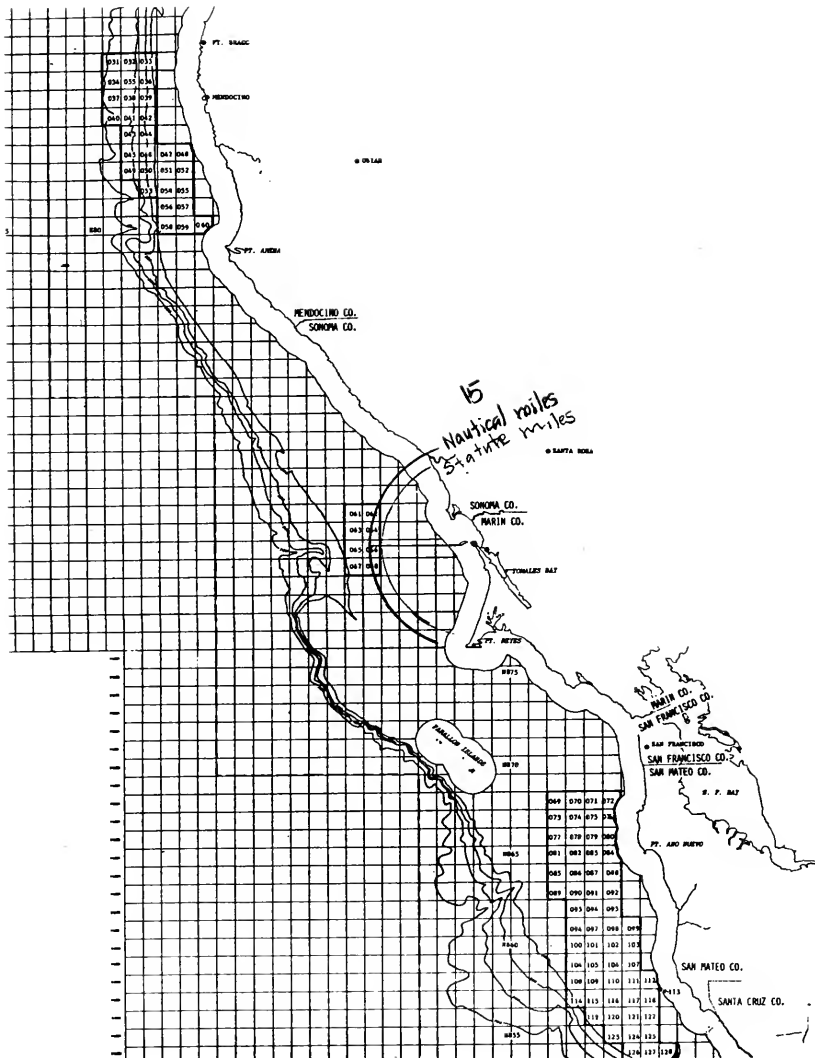


Figure 1-7. Generalized Northern California surface currents for the Davidson Season.

(November-February)



JOINT STATEMENT FROM THE PENINSULA CONSERVATION CENTER AND THE COMMITTEE FOR GREEN FOOTHILLS REGARDING CONGRESSIONAL HEARINGS ON OFFSHORE DRILLING

The Peninsula Conservation Center (PCC), since 1969, and the Committee for Green Foothills (CGF), since 1961, have been leaders in supporting the wise use of the Bay Regions land, water and air resources. Our Central and Northern California coastline, as a source of tourism, commercial fishing, wildlife habitat—including several endemic species, farmland and open space, is a unique resource. In our continuing efforts to ensure the best possible use of this area, the PCC and CGF recommends the following:

- That the environmental study time for OCS 53 be extended;
  - That these studies be completed before the sale;
  - That the environmental risk factors should not be considered as "possible impediments to comprehensive planning for leasing", as the Department of the Interior (DOI) has stated, but as issues which must be addressed;
  - That California laws, goals and policies not be excluded from the DOI's guidelines of environmental considerations. Such laws goals and policies are: predictive information on the economic and environmental losses that could result from OCS development, air and water quality, industrial capacity development, and impacts on tourism and recreation;
  - That the 24 million OCS California acres be divided up into their respective basins and judged individually. This is conducive to a more sensitive appraisal of the area, and a more precise balance between resource availability and environmental damage;
  - That the status of the studies be clarified, eg. the Geohazard study, listed as being complete in the proposed program is not available.
- The DOI set up a Marine Sanctuary around Pt. Reyes. Inconsistent with this expressed concern is the transportation scenario that would barge oil past the sanctuary. This shakes our confidence in DOI's commitment to fully incorporate environmental concerns into the decision making process. We recommend that the framework for the process be designed not only by financial considerations, but by what is necessary to provide adequate information. Without this information DOI cannot decide what is the best possible use for our Coast.

Sincerely,

KAREN NILSSON,  
*President, Peninsula Conservation Center.*

BILL LELAND,  
*President, Committee for Green Foothills.*

PREPARED STATEMENT OF MARY KYLE MCCURDY, CONSERVATION COORDINATOR OF LOMA PRIETA CHAPTER, SIERRA CLUB

California's coastline is one of the most unique natural resources of our state. The Loma Prieta Chapter of the Sierra Club believes that the best use of this resource for the long term can only be achieved through a decision-making process based on a thorough evaluation of the environmental, social and economic impact various alternative uses will have on our coast.

The Federal Outer Continental Shelf Act requires the Secretary of the Interior to develop a five year schedule for leasing areas of the Outer Continental Shelf (OSC) for oil and gas exploration and development. Of these areas, four are offshore California, including lease sale #53 off central/northern California, scheduled for 1981. The 1978 OCS Lands Act Amendments require the Department of Interior to consider eight factors in developing such a five year schedule.

We feel that the lease schedule proposed by the Department does not consider several of these factors, and gives unequal weight to those it does consider. Further, the proposed lease sale areas offshore California are so large and physically and biologically diverse, that they cannot be realistically evaluated on these Congressionally mandated factors. Moreover, local opinion has been given minimal consideration.

The OCS Lands Act Amendments stipulate that the following eight factors be taken into consideration in developing the lease sale program: (1) existing geological and ecological characteristics of the OCS regions; (2) an equitable sharing of developmental benefits and environmental risks among these regions; (3) the location of regions with respect to regional and national energy markets; (4) the location of regions with respect to other uses of the seabed and sea; (5) oil industry interest in developing certain areas of the OCS; (6) laws, goals, and policies of the affected

states which have been specifically identified to the Secretary by the states; and (8) environmental and predictive information for the OCS areas.

The Interior Department's "Proposed 5-Year OCS Oil and Gas Leasing Program—March 1980 through February 1985" does not adequately analyze these factors in a comprehensive manner. In particular, the proposed schedule does not consider the environmental sensitivity and marine productivity of the OCS areas, other uses of the seabed and sea, equitable sharing of development benefits and environmental risks among OCS areas, and environmental and predictive information. Instead, the major factor in developing the schedule seems to be the petroleum resource potential of each area, especially in regard to the Department of Energy's production goals for energy resources on federal lands. The DOE's goal for total energy production from all OCS leases through 1985 is 4.7 billion barrels of oil and 10,000 trillion cubic feet of gas.

The Department of Interior has not conducted adequate environmental studies to determine the impact of oil exploration and development. The local Bureau of Land Management office admits concern that there is not enough information and money with which to complete an adequate environmental evaluation in time for the lease sales. Further, we have not been able to obtain the few environmental studies which the Department of Interior cites as being completed. The small amount of scientific data which is included in the lease program is grossly simplified and does not even attempt a predictive assessment of the environmental impacts of these lease sales.

There are currently three proposed Federal Marine Sanctuaries in California (Santa Barbara Channel Island, Monterey Bay, Point Reyes-Farallon Islands). Sanctuary status may result in the prohibition of petroleum development in these areas, yet the OSC lease sale process only excludes leasing within 15 miles of Point Reyes, and is proceeding at a pace which could significantly damage all three areas before they can be declared as Marine Sanctuaries.

Other uses of the seabed and sea are in potential significant conflict with lease sales of the OCS. Yet the Interior scheduling program does not adequately consider the importance of local commercial fisheries, navigation requirements, and existing sealanes.

The validity of the entire schedule is called into question by the fact that five distinct offshore basins are grouped together under the Central/Northern California lease sale area, and ten basins are grouped under the Southern California lease. The physical and biological diversity of these basins makes a combined environmental evaluation meaningless. Furthermore, the oil and gas potential of the various basins appears to differ substantially. The eight factors mandated by Congress to be considered in developing a lease sale schedule can only be intelligently evaluated on a basin-by-basin basis.

The potential environmental threats of this leasing program to the coastal and marine resources of California are so extensive that the OCS leasing program should not be continued as currently designed. Oil spills associated with drilling and transportation pose a major threat to commercial fisheries, beaches, and critical wetland habitat. The current situation in the Gulf of Mexico is poignant proof of our inability to effectively control an oil spill. Much of the California coast is dependent on fishing, agriculture, or tourism, and the effect such a spill could have on these is incalculable. Such a spill would have a severe effect on California's coastal birds, sea birds, marine life, and on several endangered species.

There are also major onshore impacts that could occur as a result of offshore exploration and drilling. The necessary storage facilities, refineries, pipelines, and other associated industries could have serious consequences for local air quality, economies, and land-use decisions, and add to urban sprawl and wetland loss.

We are not categorically opposed to the exploration and possible development of the Outer Continental Shelf for oil and gas. However, the process should be conducted in a manner which is scientifically sound. The environmental, social and economic factors associated with such exploration and development should be thoroughly compiled and analyzed, and predictive assessments should be made. Such studies should be conducted on a basin-by-basin basis, and local opinion should be given high consideration and public participation encouraged. If the proper studies were conducted, it may be that certain basins offshore California support further exploration, while other areas should never be so encroached upon. Given the current environmental unknowns, the high costs of oil and gas development in the sea, and the devastating consequences of an oil spill, the Outer Continental Shelf is not an area in which to conduct a hurried and therefore inadequate energy program.

Thank you very much for taking this testimony into consideration.

# The Tropospheric Transport of Pollutants and Other Substances to the Oceans

Prepared by the  
Workshop on Tropospheric Transport of  
Pollutants to the Ocean Steering Committee  
Ocean Sciences Board  
Assembly of Mathematical and Physical Sciences  
National Research Council

NATIONAL ACADEMY OF SCIENCES  
Washington, D.C. 1978

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136 W. M. KLOCK LABOR

# 5 Metals

## I. INTRODUCTION

The evaluation of the magnitude of man's input of metals to the atmosphere and the ocean is rendered difficult by the fact that the rates of mobilization of these metals by natural processes is not well known. In contrast to the situation with many other pollutants such as synthetic organic chemicals and radionuclides, materials that have no natural sources, the metals emitted by anthropogenic processes are not readily distinguishable from those emitted by natural process. Thus, it will be necessary to characterize the total global cycle of these metals before the impact of man's activities can be assessed.

The objectives then, in this chapter, are to summarize and evaluate the existing data on the concentration of metals in the troposphere, to identify possible sources, natural and anthropogenic, for these metals, and to estimate their fluxes to the oceans.

## II. CONCENTRATION OF METALS IN THE MARINE ATMOSPHERE

There is a dearth of good-quality data on the concentration of metals in the marine atmosphere. This dearth can be attributed primarily to the

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Members of the Working Group on Metals were W. H. Zoller, *chairman*; R. Chesselet, R. Chester, R. A. Duce, E. D. Goldberg, J. Jedwab, C. C. Patterson, and D. H. Peirson.

difficulties involved in the collection of large-volume air samples free from contamination and the problem of accurately analyzing these metals in the samples at the very low concentrations that normally obtain. The analytical difficulties could be reduced by increasing the sample size. However, the probability of contamination by material advected from local sources increases with sampling duration.

In addition, the length of the sampling period might be dictated by the meteorological considerations. At the operational level, the local wind characteristics, such as the sea-breeze effect observed on many islands, can limit sampling times. More fundamentally, it may be desirable to relate sampling duration to a specific synoptic situation so that each sample is representative of an identifiable large-scale meteorological feature, i.e., a specific air-mass type or a front. (The meteorological criteria for determining sample duration are discussed in Chapter 3, Table 3.1.) In practice, the primary consideration in metals studied has been to obtain the maximum sample size consistent with the minimized possibility of contamination from local sources. Generally, the operational optimum is realized when samples are collected aboard ships or at coastal sites on islands over a maximum period of a day or two (under carefully selected and monitored wind conditions).

Reliable data on metals in the marine atmosphere have only been obtained during the last few years. These data are summarized in Table 5.1. We have excluded from this compilation all data that we believe do not conform to the sampling criteria discussed in the preceding paragraph (with one possible exception, which is noted in the table and discussed below).

The concentration of atmospheric trace substances are generally log normally distributed. For this reason, we report the geometric means in Table 5.1. However, if the flux of material between the atmosphere and the sea surface is proportional to its atmospheric concentration, then short periods of high atmospheric concentration may dominate the flux. Hence, the arithmetic mean concentration is most appropriate for flux calculations. In most cases, the arithmetic and geometric means are not very different; arithmetic means are presented only for the Bermuda and eastern tropical Atlantic data in Table 5.1. Concentration ranges are included to provide an indication of the variability at a given site.

For the purpose of comparison, we include in Table 5.1 the mean metal concentrations measured at an altitude of 600 m at sites 32 to 48 km downwind of major urban centers in the northeastern United States (Young *et al.*, 1975). These concentrations should be representative of

TABLE 5.1 Concentration of Metals in the Atmosphere (Units:  $10^{-9}$  g m $^{-3}$  of air STP)<sup>a, b</sup>

Urban Regions (1975) <sup>c</sup>				Bermuda (1973) <sup>d</sup>					
Metal	Geo. Mn.	GSD	Range	Metal	Arith. Mn.	ASD	Geom. Mn.	GSD	Range
Na	510	3	130-2300	Na	2000	1700	1600	3	200-8000
Mg	730	3	150-2030	Mg	300	200	200	2	30-900
Al	1600	2	340-3800	Al	500	600	140	6	3-3000
Ca	1200	3	410-6100	Ca	200	200	140	3	6-1100
K	400 <sup>e</sup>			K	200	200	120	3	17-1000
Fe	1700	3	380-4800	Fe	300	400	90	5	4-1900
Pb	170	3	48-1000	Pb	7	7	3	4	0.10-20
Zn	120	3	29-740	Zn	6	6	3	3	0.2-20
Mn	32	3	8-110	Mn	3	5	1.2	4	0.03-30
V	16	3	9-170	V	1.5 <sup>f</sup>	2	0.8	3	0.2-6
Cu	50 <sup>g</sup>			Cu	2	3	0.9	4	<0.08-15
Hg	0.22	3	0.9-1.3	Hg					
	14	4	2.6-153	Cr	0.5	0.7	0.3	3	<0.04-3
Ce	3 <sup>h</sup>			Ce	0.6	0.8	0.2	5	0.005-3
Cd	3 <sup>h</sup>			Cd	0.4	0.4	0.2	4	<0.01-1.6
Se	1.7	2.7	0.5-5.7	Se	0.19	0.17	0.13	3	<0.02-0.6
As	16	2	7.5-50	As	0.12	0.12	0.07	3	0.012-0.5
Co	0.97	2.0	0.42-2.8	Co	0.08	0.11	0.03	5	<0.005-0.5
Sb	3.0	2.9	0.81-12	Sb	0.03	0.03	0.014	5	<0.001-0.3
Sc	0.39	2.3	0.11-1.3	Sc	0.06	0.09	0.02	5	0.002-0.4
Th	0.3			Th	0.05	0.08	0.02	5	0.002-0.2
Ag	0.6			Ag	0.009	0.02	0.003	3	<0.002-0.08
Eu	0.056	2.8	0.016-0.21	Eu	0.009	0.012	0.003	5	<0.0002-0.05

Lerwick, Shetland Islands (1972) <sup>i</sup>				Eastern Tropical Atlantic (1974) <sup>j</sup>					
Metal	Geo. Mn.	GSD	Range	Metal	Arith. Mn.	ASD	Geom. Mn.	GSD	Range
Na	2000	2	600-5000	Na	2000	1200	1800	1.9	800-4000
Mg				Mg	300	150	200	2	90-400
Al	60	1.9	20-150	Al	70	50	50	3	12-130
Ca				Ca	150	50	150	1.4	80-200
K				K	90	40	90	1.6	40-140
Fe	70	2	19-160	Fe	50	40	40	3	10-110
Pb	30	3	<4-80	Pb	7	5	5	2	2-14
Zn	40	2	9-100	Zn	5	3	3	3	0.3-10
Mn	2	4	0.2-10	Mn	0.3	0.3	0.2	3	<0.04-0.7
V	2	2	0.4-6	V	0.15	0.13	0.10	3	<0.02-0.4
Cu	<4			Cu	0.9	0.3	0.9	1.4	0.5-1.2
Hg	<0.05			Hg	0.10	0.09	0.07	2	<0.02-0.3
Cr	1.0	3	0.07-3	Cr	0.2	0.2	0.15	3	0.02-0.4
Ce	0.08	2	0.02-0.18	Ce	0.17	0.12	0.13	2	0.04-0.3
Cd	<9			Cd					
Se	0.5	1.9	<0.1-0.9	Se	0.3	0.11	0.3	1.4	0.2-0.5
As	1.3	4	0.14-8	As					
Co	0.07	2	0.03-0.18	Co	0.04	0.02	0.03	2	0.01-0.07
Sb	0.4	3	0.09-1.7	Sb	0.16	0.15	0.11	3	0.03-0.5
Sc	0.015	1.8	0.005-0.03	Sc	0.019	0.014	0.014	3	0.003-0.04
Th	<0.04			Th	0.016	0.013	0.011	3	0.004-0.04
Ag				Ag	0.05	0.10	0.014	5	<0.007-0.3
Eu				Eu					



Northern Norway (1971-1972) <sup>a</sup>				Gulf of Guinea (1970) <sup>a</sup>			
Metal	Geom. Mn.	GSD	Range	Metal	Geom. Mn.	GSD	Range
Na	300	2	60-1500	Na			
Mg	60	2	12-180	Mg			
Al	40	2	6-130	Al			
Ca	40	1.6	15-90	Ca	1700	1.6	800-3000
K	40	1.6	15-80	K			
Fe	50	1.7	11-100	Fe	120	1.3	80-170
Pb	4	2	0.6-20	Pb			
Zn	7	1.9	1.7-30	Zn			
Mn	2	1.8	0.6-6	Mn			
V	1.2	3	0.19-5	V			
Cu	2	1.8	0.5-5	Cu			
Hg				Hg	0.2	2	0.04-0.4
Cr	0.5	2	0.18-2	Cr	0.6	3	0.11-3
Ce	0.05	2	0.016-0.3	Ce	0.17	3	0.02-0.6
Cd	0.11	2	0.02-0.8	Cd			
Se	0.2	1.7	0.10-0.5	Se			
As	1.2	3	0.19-8	As			
Co				Co	0.13	1.8	0.05-0.3
Sb	0.3	2	0.05-1.2	Sb	0.4	3	0.10-3
Sc	0.006	1.9	0.0016-0.02	Sc	0.02	1.4	0.017-0.04
Th	0.008	2	0.002-0.06	Th	0.02	1.6	0.009-0.04
Ag				Ag			
Eu				Eu	0.006	1.4	0.004-0.010

Oahu, Hawaii (1969-1970) <sup>a</sup>				South Pole (1974) <sup>a</sup>			
Metal	Geom. Mn.	GSD	Range	Metal	Geom. Mn.	GSD	Range
Na	3000	1.7	900-14000	Na	3	1.5	1.7-4
Mg	400	1.7	0.10-1.8	Mg	0.7	1.8	0.3-1.4
Al	4	3	0.5-50	Al	0.6	1.9	0.2-1.4
Ca	140	1.6	0.06-0.7	Ca	0.5	1.5	0.3-0.8
K	100	1.7	0.03-0.3	K	0.7	1.2	0.5-0.9
Fe	9	2	1.0-50	Fe	0.5	1.6	0.3-1.0
Pb	2	2	0.3-13	Pb	0.031	1.4	0.02-0.04
Zn				Zn	0.03	1.7	0.016-0.07
Mn	0.16	2	0.02-0.6	Mn	0.012	1.6	0.006-0.02
V	0.14	1.9	0.04-0.7	V	0.0013	1.5	0.0006-0.0016
Cu	1.4	2	0.2-12	Cu	0.04	1.6	0.02-0.05
Hg				Hg			
Cr				Cr	0.00431	1.7	0.003-0.010
Ce				Ce	0.00191	1.9	0.0008-0.005
Cd				Cd			
Se				Se	0.0061	1.2	0.005-0.007
As				As	0.0071	1.1	0.0067-0.0073
Co				Co	0.0006	1.2	0.0005-0.0006
Sb				Sb	0.0008	1.5	0.0005-0.0014
Sc				Sc	0.00012	1.9	0.00006-0.0003
Th				Th	0.00012	1.6	0.00007-0.0002
Ag				Ag	0.002	3	0.0007-0.009
Eu				Eu	0.000019	1.4	0.000013-0.00088

See overleaf for footnotes.

major coastal urban areas, which may well be major sources of the anthropogenic component of the metal flux to the oceans. Also presented are data from samples collected at the South Pole, this site being one of the most remote on the earth's surface. In general, the mean values for most elements in the North Atlantic samples are much less than the urban values but much higher than those from the Antarctic.

There are no data for the open ocean in the southern hemisphere that qualify for inclusion in Table 5.1. This is a serious deficiency. Data from the southern hemisphere would enable us to better assess anthropogenic impacts, because only 10 percent of the particulate pollutant sources are located in that hemisphere (Robinson and Robbins, 1973). The comparison of northern and southern hemisphere concentrations has been a valuable method for distinguishing between natural and anthropogenic sources for other trace substances such as carbon monoxide (Seiler, 1974; Newell *et al.*, 1974).

## II. SOURCES OF METALS IN THE MARINE ATMOSPHERE

### A. REFERENCE ELEMENTS AND ENRICHMENT FACTORS

There are many possible natural sources for the metals present in the atmosphere; consequently, the anthropogenic contribution to the total

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#### Footnotes to Table 5.1.

\* Sample collection notes:

<sup>1</sup> Young *et al.* (1975); \*Zoller, personal communication

<sup>2</sup> Duce *et al.* (1976a; 1976b): Samples collected for one- to two-day periods from a coastal tower 40 m above sea level. Sample collection controlled automatically by wind speed and direction. The vanadium data<sup>a</sup> are from ship-collected samples near Bermuda (Duce and Hoffman, 1976). The number of samples analyzed was 29-65.

<sup>3</sup> Rahn (1976): Samples collected for one- to two-week periods at Skogavarre near ground level. Collection location about 75 km from the open sea. No control of sampling. The number of samples analyzed was 21.

<sup>4</sup> Crozat *et al.* (1973): Samples collected from a ship for one-day periods on a 5-m-high bow mast, about 8 m above water level. Samples collected only when the ship was heading into the wind. The number of samples analyzed was 9.

<sup>5</sup> Peirson *et al.* (1974): Samples collected for one-month periods 0.5 km from the sea, near ground level but 75 m above sea level. No control of sampling. The number of samples analyzed was 11.

<sup>6</sup> Cheschelet *et al.* (1973): Samples collected from a ship for one-day periods on a bow tower extending 6 m forward of ship and approximately 8 m above water level. Sample collection controlled automatically by wind direction. The number of samples analyzed was 8.

<sup>7</sup> Hoffman *et al.* (1972); Hoffman and Duce (1972): Samples collected for one-day periods from a windward coastal tower 20 m above sea level. Samples collected only during extended continuous periods of onshore tradewinds. The number of samples analyzed was 56-119.

<sup>8</sup> Maenhaut *et al.* (1977); \*Zoller *et al.* (1974): Samples collected for approximately one-week sampling periods 6 m above ice level at an elevation of 2800 m above sea level. Collection controlled automatically by wind speed and direction and condensation nuclei counts. Data presented are generally from samples collected on Whatman 541 filters. Higher concentrations were observed for Pb, Se, and Sb in samples collected with 0.4- $\mu$ m Nuclepore filters, suggesting that these elements are primarily present on very small particles. The number of samples analyzed was 4-10.

<sup>a</sup> In column head: GSD, geometric standard deviation; ASD, arithmetic standard deviation.

burden is not easily assessable. One approach to resolving the inputs from the various sources is to attempt to identify reference elements that are characteristic, or indicative, of specific natural sources. Ideally, a reference element must be amenable to relatively simple and accurate analysis, and it must be present in high concentration in aerosols produced by the source for which it serves as a reference and in low concentration in aerosols from other sources.

There is general agreement that the major portion of the aerosol mass over the oceans is derived from two sources: the sea itself, as spray from the bursting of bubbles, and the earth's crust, as mobilized soil material. Although a number of major constituents of seawater have been used as reference elements for that source, Na is generally preferred. Commonly used as reference elements for crustal weathering products are Al, Fe, Si, and Sc.

Of these, Si is probably best suited for this purpose. However, Al is used often because the analytical procedure is simpler and more accurate than that for Si.

For any element in an aerosol sample, we can define an enrichment factor relative to a reference element in a specific source. For seawater, using Na as the reference element, the enrichment factor,  $EF_{sea}$ , for an element,  $X$ , is

$$EF_{sea} = (X/Na)_{air} / (X/Na)_{sea}, \quad (5.1)$$

where  $(X/Na)_{air}$  and  $(X/Na)_{sea}$  refer, respectively, to the ratio of the concentration of metal  $X$  to that of Na in the atmosphere and in bulk seawater. Likewise, for crustal weathering products,

$$EF_{crust} = (X/Al)_{air} / (X/Al)_{crust}. \quad (5.2)$$

If the concentration of any element in an air sample yields an  $EF_{sea}$  or an  $EF_{crust}$  value that is close to unity, then one can assume that the most probable source for that element in the aerosol was, respectively, seawater or crustal material. Some caution must be exercised in interpreting enrichment factors. With respect to  $EF_{sea}$  values, the principal assumption is that the composition, relative to Na, of atmospheric sea-salt particles produced by bursting bubbles at the air-sea interface is identical to the composition of bulk seawater. However, it has been shown that this is not the case for many substances, such as iodine (Seto and Duce, 1972), phosphate (MacIntyre and Winchester, 1969), and total organic carbon (Barger and Garrett, 1970; Hoffman and Duce, 1976). These substances are significantly enriched in atmo-

spheric sea-salt particles relative to bulk seawater. This fractionation is due, in part, to the association of these substances with surface-active organic compounds, which are scavenged by rising bubbles and transported to the water-atmosphere interface. Thus, the oceanic surface microlayer, which serves as the source for some of the material in the atmospheric sea-salt particles, becomes enriched with these materials relative to subsurface seawater. Many metals are known to be concentrated in the top several hundred micrometers of the air-sea interface (Piotrowicz *et al.*, 1972; Szekiolda *et al.*, 1972; Barker and Zeitlin, 1972). It is expected that these metals will also be enriched in any sea-salt particles that incorporate material from the surface microlayer. The magnitude of the enrichment for these metals and its geochemical significance remain subjects of debate (Chesselet *et al.*, 1976; Peirson *et al.*, 1974; Van Grieken *et al.*, 1974). However, Duce *et al.* (1976b) have presented strong evidence that Fe, Zn, and Cu are enriched by a factor of several hundred on atmospheric sea-salt particles produced by bubbles bursting in coastal waters.

Crustal enrichment factors do not enable us to distinguish between that crustal material which is injected into the atmosphere as a consequence of natural processes and that which is mobilized as a result of man's activities. The latter include increased exposure and breaking of soil surfaces for agricultural usage and in land-clearing operations; the production of crushed stone, sand, and gravel; and the suspension of soil particles by vehicular traffic. The interpretation of EF values is further complicated by the fact that many anthropogenic activities yield products (for example, coal and fly ash) in which many elements have relative concentrations that are similar to those of average crustal material. Moreover, one would not necessarily expect naturally derived soil aerosols to have a composition identical to that of average crustal material. First, the composition of rocks and soils varies from region to region. Second, the composition of the mobilized fraction of the soil may be different from that of the bulk soil material. Thus, EF<sub>crust</sub> ratios greater or less than unity do not necessarily preclude a crustal source.

Despite these limitations, the determination of EF<sub>sea</sub> and EF<sub>crust</sub> values can yield useful information on possible ocean and crustal sources for many metals. Enrichment factor values much greater than unity—a factor of 10 or more—alert us to metals that may be derived from other sources. Metals in the latter group, those that are apparently nonmarine and noncrustal in origin, may have major anthropogenic sources. It is these metals that ultimately may be of greatest concern.

## B. THE OCEAN

With the exception of the alkali and alkaline earth elements, the  $EF_{sea}$  values for all the metals listed in Table 5.1 are very large, with values ranging from hundreds to tens of thousands. In contrast, the  $EF_{sea}$  values for Mg, K, and Ca are generally in the range of  $1 \pm 0.1$  in aerosols collected on the coast of Hawaii and from ships over the North Atlantic (Hoffman and Duce, 1972; Hoffman *et al.*, 1974). Slightly higher  $EF_{sea}$  values for these metals have been observed (Chesselet *et al.*, 1972; Buat-Menard *et al.*, 1974). These higher values could be attributable to the presence of significant quantities of crustal aerosols in the atmosphere in these regions. However, there is some evidence that  $EF_{sea}$  values for K may be higher in atmospheric sea-salt particles generated in regions of upwelling water (Buat-Menard *et al.*, 1974), possibly as a consequence of the increased biological productivity.

## C. CRUSTAL WEATHERING

A compilation of representative  $EF_{crust}$  values is presented in Table 5.2. These data suggest that weathered crustal material is the primary source of Sc, Fe, Mn, Ce, Eu, and Co (i.e., their  $EF_{crust}$  values are considerably less than 10). However, a number of elements are highly enriched relative to both the crust and seawater; these are Zn, Cu, Cd, Hg, Sb, Ag, As, Pb, and Se. Interest centers on these elements because of the possibility that they might have a significant anthropogenic component. Zoller *et al.* (1974) pointed out that most of these highly enriched elements, and their oxide or halide compounds, have a relatively low boiling point.

If a significant fraction of the earth-atmosphere flux of these metals involves a vapor phase, then we would expect their concentration to be relatively greater in submicrometer particles. The aerosol surface area is greatest in the submicrometer-size range, and, consequently, the effects of sorption, condensation, and surface reactions should be most apparent on these particles. This size dependency has been most clearly demonstrated in studies of aerosol composition and size distribution in urban areas. Generally, it is found that the total aerosol mass distribution is essentially bimodal (except in the immediate vicinity of major sources) with a saddle point at approximately  $2\text{-}\mu\text{m}$  diameter (Whitby *et al.*, 1975; Sverdrup *et al.*, 1975). Particles larger than a few micrometers in diameter are generated by natural and anthropogenic mechanical (comminution) processes, while most of the particles below

TABLE 5.2 Mean Crustal Enrichment Factors for Metals in Atmospheres

Element	Urban Regions <sup>a</sup>	Lerwick Shetland Is. (1972) <sup>b</sup>	Bermuda (1973) <sup>c</sup>	Eastern Tropical Atlantic (1974) <sup>d</sup>	North Coast of Norway (1971-1972) <sup>e</sup>	Gulf of Guinea (1970) <sup>f</sup>	Oahu, Hawaii (1969-1970) <sup>g</sup>	South Pole (1974) <sup>h</sup>
Sc	0.8	0.9	1.1	1.2	0.6	0.8	—	0.8
Al	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Fe	1.2	1.7	1.0	1.1	1.9	1.7	2.6	1.2
Th	0.7	3.8	2.1	2.4	1.8	—	—	1.6
Mn	1.4	4.6	0.7	0.5	5.0	—	2.6	1.4
Ce	1.1	1.7	3.6	4.3	2.3	2.6	—	4.4
Eu	3.8	—	2.5	—	—	—	—	1.9
Co	1.8	2.8	1.8	2.4	6.3	4.0	—	2.6
Cr	14	15	1.7	3.2	12	6.8	—	6.9
V	17	24	17	1.8	24	—	15	1.1
Zn	200	790	26	480	240	—	—	50
Cu	21	77	12	22	79	—	450	84
Pb	1,800	3,300	180	720	800	—	2,900	240
As	89	1,500	50	—	1,900	—	—	510
Ag	200	—	52	1,400	—	—	—	2,600
Hg	570	<700	≥65	1,800	—	1,800	—	—
Sb	910	3,600	180	3,700	3,600	2,400	—	410
Cd	340	—	570	—	1,200	—	—	—
Se	3,600	12,000	2,600	17,000	10,000	—	—	16,000

<sup>a</sup> Young *et al.* (1973), Zoller (personal communication).<sup>b</sup> Pearson *et al.* (1974).<sup>c</sup> Duce *et al.* (1976b), except for V, which is from Duce and Hoffman (1976).<sup>d</sup> Chesselet *et al.* (1975).<sup>e</sup> Rahn (1976).<sup>f</sup> Crozat *et al.* (1973).<sup>g</sup> Hoffman *et al.* (1972).<sup>h</sup> Muenbaht *et al.* (1977), except for Ce and Cr, which are from Zoller *et al.* (1974).

a few micrometers in diameter are produced either directly in combustion processes or indirectly from the condensation of chemical or photochemical reaction products. In urban areas, metals in the small-particle mode are generally characterized by large  $EF_{\text{crust}}$  values; examples are Cu, As, Hg, Zn, Sb, and Pb (Paciga and Jervis, 1976). In contrast, metals concentrated in the large-particle-size fraction (Fe, Sc, Co, and Mn) have low  $EF_{\text{crust}}$  values (Paciga and Jervis, 1976) and are assumed to be soil-derived.

There are few data on the size distribution of metals in marine aerosols. However, one major study (Duce *et al.*, 1976a) has shown that, in aerosols collected at Bermuda, the metals having high  $EF_{\text{crust}}$  values were concentrated in the submicrometer-size range, whereas the oceanic and crustal-source metals were concentrated in the larger particles. Also, supporting evidence comes from an aerosol size study made in coastal cities (Johansson *et al.*, 1974); these data show that the size dependence of the metal concentrations in air masses with an oceanic trajectory is essentially the same as that in air masses with a continental trajectory.

It would appear, then, that the metals having high  $EF_{\text{crust}}$  values are derived from the continents and are products of vaporization-condensation/sorption processes. These volatilization processes could be anthropogenic; however, there are a number of natural processes, some of which will be discussed below, that possibly could produce the same results.

#### D. POLLUTION

There are several major anthropogenic sources of atmospheric heavy metals: the combustion of fossil fuels (coal, gasoline, lignite, and oils), the incineration of waste, and the emissions from cement plants and other industrial sources. The fluxes of some heavy metals to the atmosphere from these sources can approach, or even exceed, natural fluxes to the marine environment (Study Panel on Assessing Potential Ocean Pollutants, 1975). For some individual heavy metals, single dominant sources often can be identified in certain regions. Examples include lead from the combustion of lead alkyls in gasoline (Murozumi *et al.*, 1969), vanadium from residual oil combustion (Zoller *et al.*, 1973), arsenic from smelters (Crecelius *et al.*, 1974), and cadmium from incinerators (Greenberg *et al.*, 1977). Many of these metals are released to the atmosphere from high-temperature combustion processes; these

metals are primarily associated with submicrometer particulate material in urban areas as discussed above.

There are two categories of discrete particles found in the air and the sea that are exclusively man-made and that can easily and unambiguously be identified by electron microscope and microprobe techniques. These are automobile exhaust particles and inorganic pigments. These materials are stable in air and water and, because of their small size and long residence times, are widely distributed. Because the annual production figures for these substances are a matter of record, they can be used as tracers for the study of the dispersion of particulate anthropogenic materials. As yet, exhaust and pigment particles have not been systematically studied, and there are few data on their fluxes, their concentrations at various levels in the atmosphere and oceans, or their geographical distributions.

## E. OTHER SOURCES

Although the concentrations of metals in the atmosphere in remote regions can vary by several orders of magnitude, the  $EF_{\text{crust}}$  values generally do not. The similarities between the  $EF_{\text{crust}}$  values at several of the widely distributed sites given in Table 5.2 have been noted and discussed by Duce *et al.* (1975); they suggest that the geographical uniformity of  $EF_{\text{crust}}$  values may indicate that natural sources or processes could be responsible for some of the observed enrichments. Possibilities include the following.

### 1. Low-Temperature Volatility and Crustal Degassing

Low-temperature vaporization of some metals or their compounds from crustal rocks has been postulated to take place (Goldberg, 1976). Degassing of the earth's crust may be the major source of atmospheric mercury (Weiss *et al.*, 1971).

### 2. Biological Mobilization

Life processes can mobilize heavy metals to the atmosphere. For example, the methylation of arsenic and selenium by land plants and the subsequent release of the methyl arsenides and methyl selenides has long been known. Wood (1974) points out that methylated forms of As, Hg, S, and Se can be produced by microorganisms in the marine environment. More recently, evidence has been obtained that suggests that growing plants release zinc compounds to the atmosphere



(Beauford *et al.*, 1977). The importance of biological mobilization is yet to be established on a global basis.

### 3. Volcanic Activity

Heavy metals are introduced to the atmosphere intermittently through volcanic activity. Intense volcanic eruptions can directly inject particulate and gaseous materials into the stratosphere as well as the troposphere; as a consequence, these materials can be rapidly mixed throughout the atmosphere. Estimates of the mass yield of particles from volcanoes vary widely, but recent measurements suggest that yields could be quite large (Hobbs *et al.*, 1977). The metal output of volcanoes via the high-temperature volatilization mechanisms is unknown. However, the metals with high  $EF_{\text{crust}}$  values in Table 5.2 also have very high  $EF_{\text{crust}}$  values in particles collected in the fumaroles and vents of active volcanoes (Cadle *et al.*, 1973; Mroz and Zoller, 1975; Duce *et al.*, 1976b).

### F. METAL FLUXES TO THE ATMOSPHERE

One approach to understanding the origins of metals in remote areas is to estimate the global fluxes of each metal to the atmosphere from known sources to ascertain if any one source could be dominant. To this end, we have assembled calculations for the total fluxes of metals from crustal material, sea salt, and fossil fuels to the atmosphere (Table 5.3). It should be noted, as mentioned previously, that there may be other natural and anthropogenic sources for these aerosol metals. However, there is currently no information on which to base a calculation of the global fluxes of metals from these other sources.

The total mass flux of crustal material to the atmosphere has been estimated to be  $2.5 \times 10^{14}$  g yr<sup>-1</sup> (Goldberg, 1971); the average crustal abundances of Taylor (1964) were used to convert this total crustal mass flux to elemental fluxes. The flux of sea-salt particles to the atmosphere is estimated to be  $1 \times 10^{15}$  g yr<sup>-1</sup> (Eriksson, 1959). The sea-salt flux is converted to a metal flux using the average seawater concentrations reported by Riley (1975) and by Chester and Stoner (1974). This calculation assumes that no element fractionation occurs during sea-salt particle production. The flux of heavy metals from the combustion of coal, lignite, oil, and natural gas is taken from Bertine and Goldberg (1971). The flux of submicrometer lead to the atmosphere from anthropogenic processes (primarily the combustion of leaded fuels) is taken from Patterson *et al.* (1976).

TABLE 5.3 Global Flux of Metals to the Atmosphere Based on Total Crustal Material Flux of  $2.5 \times 10^{14}$  g/yr<sup>a</sup> and Total Sea-Salt Flux of  $1 \times 10^{15}$  g/yr<sup>b</sup>

Element	Crustal Material <sup>c</sup> 10 <sup>9</sup> g/yr	Bulk Sea Salt <sup>d</sup> 10 <sup>9</sup> g/yr	Fossil-Fuel Combustion Products <sup>e</sup> 10 <sup>9</sup> g/yr
Al	20,000	0.15	1400
Fe	14,000	0.5	1400
Na	6,000	$3 \times 10^5$	300
Mn	200	0.005	7
Sc	6	0.000015	0.7
Cu	14	0.04	2
V	30	0.05	12
Cr	0.013	0.003	0.5
Pb	3	0.0008	150 <sup>f</sup>
Cd	0.05	0.0008	—
As	0.5	0.05	0.7
Zn	18	0.08	0.5
Sb	0.05	0.007	—
Hg	0.02	0.0005	1.6

<sup>a</sup> Goldberg (1971).

<sup>b</sup> Eriksson (1959).

<sup>c</sup> Using crustal abundances of Taylor (1964).

<sup>d</sup> Using seawater concentrations of Riley (1975) and Chester and Stoner (1974).

<sup>e</sup> From estimates of Bertine and Goldberg (1971).

<sup>f</sup> Estimate of Patterson *et al.* (1976).

It is clear, from Table 5.3, that the crustal sources dominate the sea salt and fossil-fuel sources for most metals. The notable exceptions are Na from the oceans and V, Se, Hg, and Pb from the combustion of fossil fuels and leaded gasoline.

#### IV. FLUXES OF METALS FROM THE ATMOSPHERE TO THE OCEAN

##### A. NEARSHORE

There have been relatively few field studies of the atmospheric input of materials to coastal areas. Cambray *et al.* (1975) have attempted to measure the deposition of metals from the atmosphere into the North Sea by analyzing material collected in continuously open rain collec-

tors exposed at several coastal sites for periods of approximately one month per sample. Samples collected in this manner over such a long period of time have a high probability of being contaminated by material from local sources; however, the investigators selected the sites carefully to minimize such contamination. On the basis of these measurements, integrated over a one-year period (1972–1973), Cambray *et al.* (1975) estimate that the annual atmospheric input of Fe, Pb, Zn, and Cu to the North Sea may be greater than 10 percent of the steady-state concentration of these metals in the water.

Patterson and Settle (1974) measured the atmospheric input of Pb into a 12,000 km<sup>2</sup> area of the Southern California Bight. They found that atmospheric transport accounted for 45 percent of the pollutant Pb input, the balance being carried by waste-water discharges, river input, and storm runoff.

These field studies clearly illustrate the potential importance of atmospheric deposition to nearshore marine pollution.

## B. OPEN OCEANS

It is impossible at present to make any realistic estimate of the atmospheric transport of metals to the global ocean because of a complete lack of data from many regions, the most critical being the southern hemisphere. The data coverage is best in the North Atlantic, where there are several sets of data from different areas and covering relatively extended periods of time (see Table 5.1). With these data, mean deposition rates can be calculated on the basis of a simple model.

The model assumes that the metal-bearing aerosols are distributed uniformly from the sea surface to 5000 m. This distribution is based, by analogy, on measurements of a number of continentally derived non-pollutant elements (Gillette and Blifford, 1971). (There are virtually no data on metal concentrations at altitudes greater than a few meters above sea level.) The model further assumes that the atmosphere is washed clean of particles 40 times each year. This rain statistic is based on the fact that the average residence time of water vapor in the troposphere ranges from 8 days at low latitudes to about 15 days at high latitudes (Junge, 1963). Obviously, this crude calculation can yield only a rough estimate of the total deposition; however, the limitations of the data do not warrant a more sophisticated treatment.

The most representative data sets for the North Atlantic are those obtained by Duce *et al.* (1967b) for the period June through September 1973, from a 40-m tower at Bermuda, and by Chesselet *et al.* (1975) for April and May 1974, from a ship in an area of the eastern tropical

Atlantic between 18 and 36° N and 18 and 30° W (Table 5.1). Neither set of samples was collected in the plume of dust that periodically emerges from the Sahara and crosses the Atlantic in the northeast trade-wind belt. The eastern tropical Atlantic data were weighted twice as heavily as the Bermuda data because the former are more representative of the open Atlantic.

The weighted arithmetic means (Table 5.4) are used in making the flux calculations. Using atmospheric Fe as an example, we obtain the following input for Fe:  $130 \text{ ng m}^{-3} \text{ STP} \times 40 \text{ washouts yr}^{-1} \times 5000 \text{ m}^3 \text{ STP m}^{-2} = 2.6 \times 10^{-2} \text{ g m}^{-2} \text{ yr}^{-1}$ .

The calculated deposition rates of metals to the North Atlantic ocean surface are given in column 3 of Table 5.4. How do these estimated atmospheric inputs compare with the input of these elements to this region from all sources? To answer this question, we estimate the total input on the basis of the known elemental composition of the deep-sea sediments and the measured sediment accumulation rates. (This calculation assumes, of course, that the oceans are in steady state.) The calculated sediment fluxes, based on a mean deep-sea clay sedimentation rate of  $12 \text{ g m}^{-2} \text{ yr}^{-1}$  (Turekian, 1965), are given in column 4 of Table 5.4. The last column of Table 5.4 presents the

TABLE 5.4 Estimated Flux of Metals to the North Atlantic Ocean

Metal	Atmospheric Concentration <sup>a</sup> (ng m <sup>-3</sup> STP)	Atmospheric Flux to Ocean (g m <sup>-2</sup> yr <sup>-1</sup> )	Sediment Deposition <sup>b</sup> (g m <sup>-2</sup> yr <sup>-1</sup> )	Atmospheric Input (% of Sed. Input)
Fe	130	$3 \times 10^{-2}$	$7.8 \times 10^{-1}$	4
Al	200	$4 \times 10^{-2}$	$1.0 \times 10^0$	4
Mn	1.2	$2 \times 10^{-4}$	$8.0 \times 10^{-2}$	0.3
Sc	0.03	$6 \times 10^{-6}$	$2.3 \times 10^{-4}$	3.0
Zn	5	$1 \times 10^{-3}$	$2.0 \times 10^{-3}$	51
Cu	1.3	$3 \times 10^{-4}$	$3.0 \times 10^{-3}$	10
Cd	0.3	$6 \times 10^{-5}$	$5.0 \times 10^{-6}$	1200
V	0.6	$1.2 \times 10^{-4}$	$1.4 \times 10^{-3}$	8
Sb	0.12	$2 \times 10^{-5}$	$7 \times 10^{-6}$	300
Pb	7	$1.4 \times 10^{-3}$	$9.6 \times 10^{-4}$	150
Hg	0.10	$2 \times 10^{-5}$	$8.0 \times 10^{-6}$	250
As	0.1	$2 \times 10^{-5}$	$1.6 \times 10^{-4}$	13
Se	0.3	$6 \times 10^{-5}$	$2.0 \times 10^{-6}$	2900

<sup>a</sup> Weighted mean from data in Table 5.1 (see text).

<sup>b</sup> Calculated on the basis of deep-sea clay composition given by Turekian and Wedepohl (1961) as presented in *Geochemical Tables*, H. V. Rosler and H. Lange, eds. (Elsevier, New York, 1972), pp. 236-239, except for Hg (Bertine and Goldberg, 1971) and Sb (Duursma, 1973).

computed atmospheric input expressed as a percentage of the sediment deposition rate for each metal. The calculated percentage atmospheric inputs are subject to considerable uncertainty. Nonetheless, highly anomalous values can alert us to important processes or sources that might not otherwise be considered. In Table 5.4, the atmospheric input percentage values for Al, Fe, Cu, Mn, V, As, and Sc are reasonable. However, the atmospheric input rate for Zn is high, and those for Cd, Sb, Pb, Hg, and Se are greater than the deposition rates of these elements to the sediments. The elements in the high atmospheric deposition rate group are also among those that are anomalously enriched in the aerosol.

There are several possible explanations for the high atmospheric input rates for these elements:

1. The primary sources of these elements are anthropogenic, and, thus, the calculated input rates reflect a recent phenomenon in the geological time scale. The sedimentation data are long-term averages spanning many hundreds to thousands of years. Thus, an unusually high-rate, but short-term, injection would not be resolvable in the sediment record (see below).

2. A significant quantity of the metals present in the atmosphere may actually be recycled material that has been resuspended from the ocean surface. Most suspect would be those metals that are enriched in sea-salt aerosols relative to their seawater concentrations. Thus, the calculated atmospheric deposition rate would be artificially high and would not represent a true net input to the ocean.

3. The assumption that the mechanism for the removal of the metals from the atmosphere is equally efficient for all particle sizes may not be valid. Experiments indicate that aerosol removal by precipitation and by dry processes is relatively more efficient for larger particles (see Chapter 4). Thus, the actual removal rate for small particles over the oceans may be considerably less than that for large particles. As mentioned previously, measurements made on Bermuda (Duce *et al.*, 1976a) of particle composition as a function of size show that the major fraction of the mass of Cu, Zn, As, Sb, Se, Hg, Pb, and Cd is present in submicrometer particles. In contrast, Na, Al, Mn, Fe, Sc, Th, and Co are found primarily on the 1- to 5- $\mu$ m-radius particles. Thus, it would seem that the actual deposition rates of the enriched metals could be much less than that predicted by our simple model. However, if the size-selective removal of aerosols were a major effect, we would expect to see a trend of progressively increasing enrichment factors with increasing distance from continental sources. No such trend is

evident in the data in Table 5.2, but this may be attributable to the limited nature of the data base.

At present, it is impossible to determine which of these, or other factors, might be responsible for the anomalously high calculated atmospheric input values. However, it must be emphasized that a proper understanding of the nature and magnitude of the flux to the oceans will require a careful investigation of the physical processes involved, in addition to the actual measurement of deposition on the ocean.

### C. TIME RECORDS OF ATMOSPHERIC TRANSPORT TO THE OCEANS

The magnitude of anthropogenic inputs and the impact of these inputs on the global cycle of metals could be more readily assessed if we had available a chronological record of atmospheric deposition that predates the era of heavy industrialization. Such a record may be obtainable from marine sediments and glaciers.

#### 1. *Sediment Records*

Deep-sea sediments cannot be used because of the low sedimentation rates that obtain, generally, a centimeter or less per thousand years. Thus, the anthropogenic components would be confined, theoretically, to a layer less than a millimeter thick at the sediment surface. In practice, burrowing benthic organisms churn the surface sediments to depths of at least several centimeters and, in effect, homogenize the time record over a several-thousand-year period. Nearshore sediments can yield much better time resolution because of the much higher sedimentation rates (Bruland *et al.*, 1974). Burrowing organisms still pose a problem, but this can be avoided by working with sediments from anoxic basins (Bertine and Goldberg, 1977). However, the interpretation of nearshore sediment records is difficult, and the conclusions ambiguous, because of the complicating effects of inputs from rivers, sewage outfalls, and coastal runoff.

#### 2. *Glacial Records*

There is only one source for the particulate and dissolved material incorporated into glaciers—the atmosphere. Also, the chronology of the annual inputs to glaciers is readily established by a number of techniques. Certainly, the transfer mechanisms and, consequently, the

deposition rates to the glacier surface will differ from those over the ocean. However, a record of the year-to-year changes in the input rates of materials to the glacier are extremely valuable because they permit correlations to be made with known trends in (postulated) source processes such as the annual rates of fossil-fuel consumption, processing of specific raw materials, and volcanic activity.

A classic example is the study (Murozumi *et al.*, 1969) that showed that the concentration of Pb in the Greenland ice cap increased at a rate that reflected the increased industrial processing and utilization of the metal. This study was the first to demonstrate that the atmospheric transport of a metal was more than a local or regional phenomenon.

The glacial record will also provide information on the output from natural sources (such as crustal material, the ocean, and volcanoes), on the variation of these outputs with climate, and on the possible effects of output changes on climate.

However, glacier studies are fraught with difficulties, the major one being the problem of contamination during the sampling procedure. The contamination problem is severe because of the extremely low concentrations of particulate and dissolved materials in glaciers. The extreme precautions that must be taken, and the consequences of not taking them, are described by Murozumi *et al.* (1969).

## V. RECOMMENDATIONS

A. *Carefully designed field programs should be carried out in open ocean areas to measure the wet and dry deposition rates of metals to the sea surface.* Data are required for both the northern and southern hemispheres; the need for data from the southern hemisphere is urgent. Islands in midocean locations are preferred as sampling sites. Although sample collection will be difficult and contamination will continue to be a major problem, this type of study is presently feasible.

*Aerosol composition as a function of size is a critically important parameter in the determination of deposition rates;* the inclusion of such measurements into field programs should be encouraged.

B. *Investigations should be undertaken to determine the major sources of metals in the atmosphere.* Determination of sources and fluxes have equal priority. Emissions from anthropogenic sources such as smelters, cement plants, oil, and gas power plants must be measured and characterized on a global basis. *Important parameters are elemental (or chemical) composition, particle size distribution, and particle composition as a function of size.*

The importance of specific natural sources and processes such as volcanism, the biosphere, low-temperature volatilization and crustal degassing, and chemical fractionation at the air-sea interface must be evaluated.

C. *The time trends of the atmospheric transport of metals to remote areas should be established through studies of concentration changes with depth in glacier snow and ice.* With these measurements, and with a knowledge of the historical trends of anthropogenic source terms, an assessment can be made of the anthropogenic impact on a global scale. However, if glacier snow and ice is to be used for this purpose in a systematic fashion, *it will be necessary to develop new techniques for collecting larger cores using more stringent contamination-control procedures.*

D. *Immediate efforts must be made to initiate procedures or programs that will lead to an increase in the accuracy and precision of aerosol concentration and composition data.* There are two ways in which a given laboratory can verify the quality of its analytical procedures: (1) through the use of standard reference materials and (2) through participation in interlaboratory comparison exercises. Standard reference materials must be formulated according to the needs of environmental scientists working in the marine environment. At present, standards exist for metals in such solid phases as fish meal, orchard leaves, fly ash, and coal (U.S. National Bureau of Standards). Of these, only the latter two are suitable for use in some aerosol studies; however, they are of little value in the analysis of highly saline marine aerosols.

*It is essential that a mechanism be established whereby standards can be formulated and distributed expeditiously.* Often, developments in the area of environmental studies have occurred rapidly. In the past few years, there have been a number of instances where concern over the dissemination into the environment of certain elements or compounds resulted in a sharp increase in field sampling programs. In many cases, the quality of these data might have been greatly improved if standards could have been made available on short notice. At present, the U.S. National Bureau of Standards requires three years for the preparation of reference materials; this is far too slow a procedure for our purposes. Consequently, *we urge SCOR to explore the possibility of designating an appropriate international laboratory that would be responsible for the rapid preparation of and dissemination of environmental reference standards and for the organization of interlaboratory intercomparison exercises.*



## REFERENCES

- Barger, W. R., and W. D. Garrett (1970). Surface active organic material in the atmosphere, *J. Geophys. Res.* 75, 4561-4566.
- Barker, D. R., and H. Zeitlin (1972). Metal ion concentrations in sea-surface microlayer and size-separated atmospheric aerosol samples in Hawaii, *J. Geophys. Res.* 77, 5076-5086.
- Beauford, W. J., J. Barker, and A. R. Barringer (1977). Release of particles containing metals from vegetation into the atmosphere, *Science* 195, 571-573.
- Bertine, K. K., and E. D. Goldberg (1971). Fossil fuel combustion and the major sedimentary cycle, *Science* 173, 233-235.
- Bertine, K. K., and E. D. Goldberg (1977). History of heavy metal pollution in Southern California coastal zone—reprise, *Environ. Sci. Technol.* 11, 297-299.
- Bruland, K. W., K. Bertine, M. Liode, and E. D. Goldberg (1974). History of metal pollution in the Southern California coastal zone, *Environ. Sci. Technol.* 8, 425-431.
- Buat-Menard, P., J. Morelli, and R. Chesselet (1974). Water soluble elements in atmospheric particulate matter over tropical and equatorial Atlantic, *J. Rech. Atmos.* 8, 661-673.
- Cadle, R. D., A. F. Wartburg, W. H. Pollock, B. W. Ganrud, and J. P. Shedlovsky (1973). Trace constituents emitted to the atmosphere by Hawaiian volcanoes, *Chemosphere* 2, 231-234.
- Cambray, R. S., D. F. Jeffries, and G. Topping (1975). *An Estimate of the Input of Atmospheric Trace Elements into the North Sea and the Clyde Sea (1972-3)*, AERE Rep. R 7733, United Kingdom Atomic Energy Authority, Harwell, 26 pp.
- Chesselet, R., J. Morelli, and P. Buat-Menard (1972). Variations in ionic ratios between reference sea water and marine aerosols, *J. Geophys. Res.* 77, 5116-5131.
- Chesselet, R., R. Buat-Menard, and M. Lesty (1975). Trace element chemistry in aerosols over the eastern tropical Atlantic, *Jean Charcot Cruise*, MIDLANTE Progress Rep., Numerical Data DFR/CNRS, Gif-sur-Yvette, France.
- Chesselet, R., P. Buat-Menard, and C. Jehanno (1976). Trace metal associations and enrichments in oceanic microlayer derived aerosols assessed by scanning electron microscopy and the electron microprobe, presented at the American Meteorological Society, Second Conference on Ocean-Atmosphere Interactions, Seattle, Washington, March 30-April 1.
- Chester, R., and S. H. Stoner (1974). The distribution of Mn, Fe, Cu, Ni, Co, Ga, Cr, V, Ba, Sr, Sn, Zn, and Pb in some soil-sized particulates from the lower troposphere over the world ocean, *Marine Chem.* 2, 157-188.
- Crecelius, E. A., C. L. Johnson, and G. C. Hoffer (1974). Contamination of soils near a copper smelter by arsenic, antimony, and lead, *Water, Air, Soil Pollut.* 3, 337-342.
- Crozat, G., J. L. Domergue, and V. Bogui (1973). Etude de l'aerosol atmospherique en Cote d'Ivoire et dans le Golfe de Guinee, *Atmos. Environ.* 7, 1103-1116.
- Duce, R. A., and G. H. Hoffman (1976). Atmospheric vanadium transport to the ocean, *Atmos. Environ.* 10, 989-996.
- Duce, R. A., G. L. Hoffman, and W. H. Zoller (1975). Atmospheric trace metals at remote northern and southern hemisphere sites: Pollution or natural? *Science* 197, 551-557.
- Duce, R. A., B. J. Ray, G. L. Hoffman, and P. R. Walsh (1976a). Trace metal concentrations as a function of particle size in marine aerosols from Bermuda, *Geophys. Res. Lett.* 3, 339-343.
- Duce, R. A., G. L. Hoffman, B. J. Ray, I. S. Fletcher, G. T. Wallace, J. L. Fasching, Sr.,

COMMUNITY LEVEL ENVIRONMENTAL IMPACTS  
OF DECENTRALIZED SOLAR TECHNOLOGIES

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June 1979

## EXECUTIVE SUMMARY

The objective of this study is to examine the physical, spatial and land-use related impacts of decentralized solar technologies applied at the community level by the year 2000. The results of the study are intended to provide a basis for evaluating the way in which a shift toward reliance on decentralized energy technologies may eventually alter community form. This project has been conducted in parallel with two related efforts: a study of end-state community design and an analysis of institutional impediments to widespread solar technology implementation. These community level studies will supply inputs into the Technology Assessment of Solar Energy (TASE) Program which is being conducted cooperatively by six of the Department of Energy national laboratories.

The project assumes that in many physical respects, communities in the year 2000 will resemble parts of cities as they exist today and that the level and types of solar technologies identified by the "maximum solar" scenario of the Policy and Review Committee (DPR) will be used. For the purposes of this study, a land-use impact is related to competition for space and, more specifically, to insufficient collector area on-site to achieve a particular level of solar penetration.

Six land-use types representative of those found in most U.S. cities are analyzed according to solar penetration levels identified in the DPR "maximum solar" scenario for the year 2000. The scenario is translated into shares of end use demand in the residential, commercial and industrial sectors. These proportions become the scenario goals to be met by the use of decentralized solar energy systems. The percentage of total energy demand is assumed to be 36.5 percent, 18.3 percent and 22.6 percent in the residential, commercial and industrial sectors respectively. The community level scenario stipulated that a certain percentage of the total demand be met by on-site collection (e.g. photovoltaic and thermal collectors) and by passive design. This on-site solar goal is 31.9 percent (residential), 16.8 percent (commercial) and 13.1 percent (industrial).

The land-use types evaluated in this study may be thought of as "energy sensitive land-use patterns." Patterns studied are single-family detached dwellings and multiple-family row house apartments in the residential sector; strip commercial development, warehousing and central business district in the commercial sector; and central-city facilities in the industrial sector. These land-use types vary with respect to end use demand and density characteristics which influence on-site solar supply. Table 1 identifies the energy demand and density for the land-use types considered in the study.

Six different solar energy supply systems ranging from thermal collectors with current output and short-term storage (i.e. two to three days) to cogenerating photovoltaic arrays with long-term storage (i.e. between seasons) are examined. Each of these technologies has a theoretical potential to meet any given mix of end use demands based on its output of thermal and electrical energy. Table 2 lists the theoretical potential of the selected technology systems. Characteristics of the technology that determine its potential are the storage capacity, quality of energy produced and system efficiency. These factors define the proportion of demand for each land-use type that can be met if the required amount of collector area is available.

The method for analysis consists of determining the maximum on-site collector area for each land-use type in the residential, commercial and industrial sectors. This determination includes an evaluation of passive (south wall) design potential and measurements of the available unshaded collector area from aerial photographs. The evaluation of solar potential of each individual parcel is augmented with an estimation of several alternative schemes for sharing collector area among parcels in the "neighborhood." The study area as a whole is analyzed to determine the physical impacts likely to occur when achieving the scenario goal and to identify community characteristics of the natural and built environment which affect the ability of the study area to rely on decentralized solar energy technologies. Finally, the percentage of the parcel's total on-site energy demand that can be provided by each technology using the available collector is determined.

The results of the study are the following:

- Assuming a typical land-use mix of the land-use types studied, a community can achieve the DPR "maximum solar" goals for the year 2000 using on-site technologies with current performance. Table 3 contains the percent of total energy demand for each

land-use type that can be provided by the direct solar technologies.

- Of the individual land-use types, only the commercial central business district cannot achieve the scenario goal on-site. The deficit in the central business district, however, can be more than offset by the ability of other land-use types to achieve a greater level of solar development.
- In the residential sector, low density detached single-family development (i.e. urban sprawl) is not required in order to meet the solar scenario.
- Detached single-family development can achieve greater independence from conventional energy sources than denser residential patterns only by using cogenerating photovoltaic systems with long-term storage.
- Central-city industrial locations would require use of other renewable sources (e.g. cogeneration, wood or municipal residues) in addition to direct solar technologies to meet the solar scenario.
- Decentralized solar technologies can produce substantially greater amounts of on-site energy supply than the DPR scenario projects. The increased levels are limited by the quality and availability of energy supplied by a given technology and by the demand for that particular quality of energy within each land-use sector (see Table 4).
- Communities will be required to take one or more of the following actions in order to produce increased levels of on-site energy:
  - select technologies which maximize output of both thermal and electrical energy including use of long-term storage and cogenerating systems;
  - implement shared energy systems in which a number of individual energy collectors are combined with a single storage facility;

- transfer surplus thermal and electrical energy to land-use types deficient in on-site solar potential; and
  - control land development patterns through land-use regulations to eliminate environmental characteristics that constrain on-site collection.
- Environmental characteristics of a community which reduce available collector area include:
    - vegetation
    - street orientation
    - lot configuration
    - density
    - roof configuration
    - adjacent buildings

Table 5 shows the environmental characteristics which act as limiting factors in the case study areas.

- Environmental characteristics of a community which acted as limiting factors can be eliminated by use of shared energy supply systems and long-term storage (Table 5).
- Environmental characteristics of the community limit on-site collectors primarily in the higher density land-use types (i.e. multiple family residential and central business district).
- Demand for water to meet thermal storage requirements although an impact with each technology is insignificant relative to total water consumption within the community.
- Potentially significant secondary impacts may occur from the disposal of hazardous wastes associated with the working fluids.
- Visual intrusion of solar collectors will be more significant in the central business district, central-city industrial locations, and in high density residential areas than in low density commercial or residential types.

- Meeting the scenario goal in the single-family dwelling case, using on-site thermal collectors, will require the removal of 15-35 percent of the tree canopy.

In summary, the implementation of decentralized solar technology systems to meet the DPR "maximum solar" goals for the year 2000 will not produce significant physical impacts using even direct thermal technologies with current performance. All but the most dense commercial development (i.e. central business district) can achieve the solar scenario goal without a transfer of surplus thermal and electrical energy from other land-use types. In addition, these technologies can replace substantially greater amounts of on-site energy demand when communities follow various courses of action.

The results of this analysis illustrate that there are identifiable environmental characteristics that individually or collectively limit the community's ability to meet end use demand. In cases where these characteristics limit on-site collection, their influence decreases when a large number of individual installations are combined into a district system. Implementation of district systems, however, will introduce a new set of considerations involving the integration of future energy planning goals into the broader social and institutional setting.

TABLE 1  
ENERGY-SENSITIVE LAND-USE TYPES

<u>Sector</u> <sup>1</sup>	<u>Density Of Case Study Areas</u> <sup>2,3</sup>	<u>Energy Demand/Gross Acre</u> <sup>4</sup>
Residential: SFD Single Family Detached Dwellings	8 d.u./acre <sup>net</sup>	.03 x 10 <sup>10</sup> BTU
Residential: MFD Row House Apart- ments (multiple family)	31 d.u./acre <sup>net</sup>	.79 x 10 <sup>10</sup> BTU
Commercial: STRIP Strip commercial development	F.A.R. = 2.3	.13 x 10 <sup>10</sup> BTU
Commercial: WH Warehousing	F.A.R. = 4.6	.11 x 10 <sup>10</sup> BTU
Commercial: CBD Central business district	F.A.R. = 6.7	1.00 x 10 <sup>10</sup> BTU

Industrial:

In the industrial sector, central city facilities identified as adaptable to solar energy use by Battelle and ITC (1977) were selected for case study.

NOTES:

- 1 These land-use types occur in all large metropolitan areas and comprise most of the residential and commercial land area. The single case study examples of the energy-sensitive land-use types were drawn from three cities in the United States: Denver, Baltimore, and Minneapolis.
- 2 d.u. = dwelling unit
- 3 F.A.R. = floor area ratio (i.e. ratio floor area to parcel area).
- 4 See Report for calculations



Table 2  
Theoretical Potential of Six Technology Systems

<u>Technology</u>	<u>Short-Term Storage</u>	<u>Long-Term Storage</u>
Thermal collectors with performance comparable to currently available technologies	1. 70% heat 80% hot water 70% cooling <sup>1</sup>	4. 100% heat 100% hot water 100% cooling <sup>1</sup>
Thermal collectors with a 33 percent increase in efficiency and using planar reflectors to increase output 50 percent (50 percent reduction in collector area)	2. 70% heat 80% hot water 70% cooling <sup>1</sup>	5. 100% heat 100% hot water 100% cooling <sup>1</sup>
Cogenerating photovoltaics with 80 percent the output of current photovoltaics and 80 percent the output of current thermal collectors	3. 70% heat 80% hot water 100% cooling 100% power	6. 100% heat 100% hot water 100% cooling 100% power

NOTES:

1. Use of solar thermal air conditioning is assumed only for the commercial sector.

Table 3  
Percent of Total Energy Demand Provided by On-Site Solar  
Collection for Five Land-Use Types

TECHNOLOGY (with Rooftop Collectors)		LAND USE TYPES				
		Residential		Commercial		
		SFD	MFD	STRIP	CBD	WH
SHORT-TERM STORAGE	1. Thermal Collectors w/Existing Output	36.5 <sup>3</sup>	33.0 <sup>5</sup>	32.0	3.6	56.0
	2. Thermal Collectors w/Improved Output	36.5 <sup>4</sup>	44.0 <sup>5</sup>	43.0	7.2	56.0
	3. Cogenerating Photo- voltaics	59.6 <sup>5</sup>	62.0 <sup>5</sup>	35.0	6.2	78.0
LONG-TERM STORAGE	4. Thermal Collectors w/Existing Output	55.1	46.0 <sup>5</sup>	27.0	3.3	65.0
	5. Thermal Collectors w/Improved Output	55.1	66.0 <sup>5</sup>	48.0	6.7	79.0
	6. Cogenerating Photo- voltaics	79.5 <sup>5</sup>	61.0	57.0	9.1	93.0
	Scenario Goal <sup>1</sup>	36.5	36.5	18.8	18.8	18.8
	On-Site Solar Collection Goal <sup>2</sup>	31.9	31.9	16.8	16.8	16.8

## NOTES:

1. Scenario goal for all solar technologies.
2. Photovoltaic and thermal collectors; also assumes some passive design.
3. Assumes removal of up to 35 percent of the tree canopy.
4. Assumes removal of 15-20 percent of the tree canopy.
5. Includes other areas of parcel in addition to rooftops.

Table 4  
Percent of Total Energy Demand Met by Each Solar  
Technology Assuming Unlimited Collector Area

TECHNOLOGY (with Unlimited Collector Area)	LAND USE TYPES				
	Residential		Commercial		
	SFD	MFD	STRIP	CBD	WH
1. Thermal Collectors w/Existing Output	40	44 <sup>3</sup>	43	39 <sup>4</sup>	56
2. Thermal Collectors w/Improved Output	40	44	43	39 <sup>4</sup>	56
3. Cogenerating Photo- voltaics	85	86 <sup>3</sup>	86	86 <sup>4</sup>	87
4. Thermal Collectors w/Existing Output	55	66 <sup>3</sup>	61	56 <sup>4</sup>	79
5. Thermal Collectors w/Improved Output	55	66	61	56 <sup>4</sup>	79
6. Cogenerating Photo- voltaics	99	99 <sup>3</sup>	49	99 <sup>4</sup>	99
Scenario Goal <sup>1</sup>	36.5	36.5	18.8	18.8	18.8
On-Site Solar Collection Goal <sup>2</sup>	31.9	31.9	16.8	16.8	16.8

## NOTES:

1. Scenario goal for all solar technologies.
2. Photovoltaic and thermal collectors; also assumes some passive design.
3. Ability to meet this level is limited by various environmental factors.
4. Ability to meet this level would require major changes in physical form.

Table 5

Environmental Characteristics Which Limit  
On-Site Energy Supply<sup>1</sup>

NATURAL <sup>3</sup>	Energy Supply System Characteristics					
	Individual/ Short-Term Storage			Shared/ Long-Term Storage		
	Passive So. Wall	Roof	Roof <sup>2</sup> Site	(Parcels) Block	Study Area	Beyond Study Area
Latitude						
Climate						
Topography						
Obstruction of solar access by vegetation	SFD Strip CBD	SFD	SFD			

BUILT						
Street pattern: Orientation	SFD WH CBD	CBD	CBD	CBD	CBD	
Street pattern: Lot configuration	SFD MFD					
Density: Available collector area rela- tive to required collector area	SFD CBD	MFD CBD	MFD Strip CBD	CBD	CBD	
Density: Building location relative to lot lines	SFD		MFD			
Roof configuration: Area and orientation		SFD				
Obstruction of solar access by buildings	SFD, MFD Strip CBD	MFD CBD	MFD CBD	CBD	CBD	

SFD: Single Family Dwelling (detached)  
MFD: Multiple Family Dwelling  
Strip: Strip commercial development  
WH: Warehousing  
CBD: Central business district

1. Blank space indicates that no land use type is limited.
2. Site: Area on parcel not occupied by structures.
3. Latitude, climate and topography which are potential limiting factors did not constrain solar energy supply in the selected land use types.

ACKNOWLEDGEMENTS

A number of people participated in and contributed to this project. They included: Dr. Ron Ritschard, project manager and coordinator at the Lawrence Berkeley Laboratory; research assistants Amy Skewes-Cox, Bob Alston, Roger Herrera and Tom Gravel who worked on aerial photograph interpretation, and preparation of maps and tables.

We also wish to acknowledge the cooperation we received from Dennis Siglinger, Chief of Data Services and Jerry Andolsek of the Zoning Review Division, both of the Denver City Planning Department; Max Goldberg, comprehensive planner of the City of Minneapolis; and Bob Perciasepe, an environmental planner with the City of Baltimore, who provided valuable assistance in compiling the case study materials for us.

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## INTRODUCTION

The purpose of this study is to examine the physical impacts of decentralized solar technologies applied within communities. The level of solar penetration identified by the "maximum solar" scenario of the Domestic Policy and Review Committee (DPR) for the year 2000 is the solar supply goal for which impacts are evaluated. This project has been conducted in parallel with two related efforts: a study of end-state community design and an analysis of institutional impediments to widespread solar technology implementation. These community level studies will supply inputs into the Technology Assessment of Solar Energy (TASE) Program which is being conducted cooperatively by six of the Department of Energy national laboratories.

Analytic Approach

Impacts were assessed by, first, quantifying the extent to which environmental characteristics of existing land use patterns and building forms limit solar energy use in order to, second, evaluate the way in which those environmental characteristics will be impacted by its use. This approach, which is applied in a series of case studies, provides a basis for evaluating the way in which a shift toward reliance on decentralized energy technologies will impact the physical form of communities and how that form may be manipulated to avoid impacts.

The most significant physical impacts which result from the use of decentralized solar technologies are land-use impacts, i.e. they derive from the spatial requirements of the technologies. All solar technologies have such spatial or land use requirements: to convert solar energy directly into thermal or electrical energy, structures or other land area must be covered with collectors; to produce electricity from wind, land must be used as a buffer against wind flow disruption and accidents; to convert biomass into a usable energy source, land area is needed for the conversion facility and in some cases for biomass production.

The ability of a community to meet a particular solar penetration goal may be limited by: 1.) characteristics of the technology, and/or 2.) the availability of collector area.

Because decentralized solar energy use requires land area in close proximity to the site of energy end use, the potential for solar energy use within a community is influenced by that community's land-use patterns



and building forms. In some land uses there will not be enough land area on the site of the energy demand to use solar technologies to their fullest extent. The proportion of the total energy demand that can be provided by a particular solar technology depends on the quality and availability of the energy produced and the quality and temporal pattern of the energy demand. Consequently, some land-use types can produce a larger portion of their total energy demands on site using that particular technology. For example, thermal collectors with short-term storage can provide 56 percent of a warehouse's on-site energy demand and only 39 percent of a high rise commercial structure's demand since a larger portion of the warehouse's total energy demand is thermal.

A shortage of collector area may be the result of insufficient surface area. Or, there may be sufficient area but it may be shaded by vegetation or structures or it may be oriented away from south. These constraints on on-site solar supply are the result of specific characteristics of the natural and built environments: vegetation patterns, density of the development, spacing and heights of structures, street patterns, and/or architectural style and form of structures.

If there is not enough collector area on-site to meet the DPR scenario goal in the case study areas, land-use and/or energy use patterns would have to be altered in order to meet the goal. Either the characteristics which limit solar energy production would have to be manipulated to eliminate the constraint or energy demand would have to be reduced or redistributed over time to produce a pattern of energy use that could be provided by the available on-site collector area. The first, and in some cases, the second action will require changes in the form of physical development.

Because impacts within a community are a function of the level of solar supply attainable with a particular technology and of the particular environmental characteristics of the land use in which it is implemented, these factors are evaluated first in order to identify impacts. Then, impacts can be compared among various land use patterns.

The comparison of solar potential of different land use patterns is meaningful only if it can be translated into a measure of the remaining consumption of nonrenewable energy sources. Decentralized energy use is only a means to an end, i.e. reduction of centralized power production and consumption of nonrenewable resources. Therefore, it is not the level of solar energy penetration but the remaining consumption of nonrenewable

fuels that ultimately provides the basis for comparing land-use patterns.

This study is necessarily limited by the scenario-defined technology mix and by its specific purpose. Variables, alternatives and influences that are equally important to land-use related energy planning in a community have been ignored. Three primary considerations which have not been incorporated into the study are the potential for passive design and cogeneration to reduce community energy demands and the role of transportation-related energy consumption. Points at which cogeneration and passive design would logically be used are identified in the case studies. The study as a whole attempts to provide a basis for evaluating the relationship between on-site energy savings and transportation energy savings by linking the analysis of potential impacts to the density of land use patterns.

### Land Use Patterns Evaluated

Because impacts vary with the land use pattern in which a technology is used, the impact analysis is conducted for six land use patterns representative of most of the development in U.S. cities and suburbs. The land use types evaluated in this study may be thought of as "energy sensitive land-use patterns". Patterns studied are single-family detached dwellings and multiple-family <sup>townhouses and low rise and high rise</sup> row houses, <sup>and</sup> apartments in the residential sector; strip commercial development, warehousing and central business district in the commercial sector; and central-city facilities in the industrial sector.

The primary criteria used to categorize land uses were those variables expected to influence on-site solar energy reliance, i.e. those variables affecting supply and demand. Solar supply is determined primarily by land use availability and, therefore, can be correlated with <sup>intensity, i.e. on-site</sup> density of land use. Demand is determined by the quantity and quality of ~~end use energy end use~~ <sup>requirements</sup>. These <sup>vary among land use sectors and</sup> ~~are~~ <sup>in turn</sup> are influenced by land use density, ~~to which the~~ <sup>selected to optimize the use of the available supply to meet the demand.</sup> solar technology <sup>is</sup> must be ~~matched~~. Most urban and suburban development in the U.S. is composed of land use patterns similar to these <sup>six</sup> types. Industrial land use is not as well represented as residential and commercial uses because individual sites are more variable both in land use and energy use patterns and because no suburban sites were analyzed. However, some conclusions can be drawn on the basis of studies which have compared land area available on suburban industrial sites to that available on central city sites (Boykin, 1974).

Physical characteristics of these land use types remain much the same regardless of geographic location. Consequently, although energy demand and solar energy supply vary in absolute value geographically as climate and latitude change, the differences in that demand and supply among land use patterns will remain relatively consistent. Similarly, although the land use mix <sup>i.e. proportions of various patterns</sup> is expected to change in the next 25 years, i.e. increased density and more multiple family residential units, the <sup>characteristics of the</sup> patterns themselves are less likely to change significantly. ~~It should be pointed out,~~ <sup>obviously,</sup> ~~that~~ land use patterns could change if there were a compelling reason, e.g. economic or regulatory. For example, new development between 1980 and 2000 could be modified to minimize impacts of solar energy use, especially of passive design (see Living Systems, 1976 and 1979; McClenon, 1977; Harwood, 1976). One of the purposes of the project is to identify which

characteristics of physical development need to be manipulated in various land use patterns to increase on-site solar reliance. Consequently, it will identify more impacts than are likely to occur if environmental constraints on solar energy use are taken into consideration in land use planning and design in the next 20 years.

#### Case Study Examples Selected

The specific case study examples selected for analysis are intended to represent densities and building forms most typical of each land use pattern. The land use and energy characteristics of the six case study areas are summarized in Table 1.

To be most informative, <sup>an</sup> analysis of this type would evaluate a series of morphologically different cities within a range of climatic conditions. This was clearly outside the scope of the study. However, five cities were initially identified as representative of a range of morphological and climatic conditions. Evaluation was limited to those cities for which land use and energy use data were available and in which climate was most representative of average U.S. conditions. <sup>Q: The residential and commercial case studies were selected from Baltimore and Denver.</sup> Baltimore is considered to be representative of the national average, weighted by population (Hittman, 1973) with peak energy demands in the summer. Denver is an example of the growing sunbelt cities which are assumed to be best suited for solar energy use with a relatively high heating demand and winter peak demands. Baltimore is an older metropolitan region with a high density core surrounded by low-density suburbs. Denver is a newer, more uniformly medium-to-low density metropolitan area. Both are mid latitude cities (40° North latitude). <sup>are</sup> The industrial case studies <sup>are</sup> located in Minneapolis at 45° North latitude. Although Minneapolis experiences more extreme climatic conditions than the national average, insolation rates are comparable to those in Baltimore (ITC, 1978). Therefore, the potential for solar energy use in industrial applications remains comparable.

#### Energy Supply and Demand Characteristics

The level of solar penetration established by the Policy Planning Review Commission's maximum solar scenario for the year 2000 was given as the context in which to evaluate impacts. This energy supply scenario identifies a national solar penetration goal for each primary energy use

TABLE 1

## ENERGY-SENSITIVE LAND-USE TYPES

Sector <sup>1</sup>	Density Of Case Study Areas <sup>2,3</sup>	Energy Demand/Gross Acre <sup>4</sup>
Residential: SFD Single Family Detached Dwellings	8 d.u./ <sup>net</sup> acre	.03 x 10 <sup>10</sup> BTU
Residential: MFD Row House Apart- ments (multiple family)	31 d.u./ <sup>net</sup> acre	.79 x 10 <sup>10</sup> BTU
Commercial: STRIP Strip commercial development	F.A.R. = 2.3	.13 x 10 <sup>10</sup> BTU
Commercial: WH Warehousing	F.A.R. = 4.6	.11 x 10 <sup>10</sup> BTU
Commercial: CBD Central business district	F.A.R. = 6.7	1.00 x 10 <sup>10</sup> BTU

## Industrial:

In the industrial sector, central city facilities identified as adaptable to solar energy use by Battelle and ITC (1977) were selected for case study.

## NOTES:

- 1 These land-use types occur in all large metropolitan areas and comprise most of the residential and commercial land area. The single case study examples of the energy-sensitive land-use types were drawn from three cities in the United States: Denver, Baltimore, and Minneapolis.
- 2 d.u. = dwelling unit.
- 3 F.A.R. = floor area ratio (i.e. ratio <sup>of</sup> floor area to parcel area).
- 4 See ~~Report~~ for calculations.  
*Appendix D*

sector, i.e., transportation, industrial, and a combined residential/commercial sector, assuming a \$32 per barrel petroleum cost. This scenario is used as a market penetration goal against which to evaluate land use and environmental impacts.

The national goal, expressed as equivalent units of fossil fuel, was converted into delivered energy consumption values assuming a primary-to-end use energy conversion efficiency of 31 percent for electricity, 70 percent for gas as a direct fuel and 60 percent for oil as a direct fuel, and assuming that residential and commercial consumption is equally divided between the two sectors. The proportion of each sector's energy consumption represented by these values is considered as the solar share of end use energy consumption to be met in each community in all land uses within that sector. Table 2 expresses solar reliance goals of the DPR scenario as percentages of end use energy. ~~¶~~ In some land use<sup>s</sup>, meeting the DPR scenario goal produced no land use impacts, even with currently available technologies. In order to evaluate the relationship between decentralized energy use and impacts more thoroughly, constraints and impacts were also evaluated for ~~a second~~ <sup>an additional, higher</sup> solar supply goal: the maximum proportion of each study area's energy demand that could be provided by each direct solar technology assuming that collector area is not limited. This is referred to as the technology's potential. Comparison of the solar supply achievable in each study area with the technology's potential allows for the identification of all situations in which environmental characteristics limit on-site solar supply for each technology evaluated.

The technology mix identified in the DPR scenario emphasizes direct on-site solar technologies. Direct solar technologies are <sup>expected</sup> to provide 75 percent of the total penetration, with biomass providing 18 percent, largely in the industrial sector, and wind providing 7 percent. Consequently, this study will focus on the impacts of direct <sup>active</sup> solar technologies.

#### Technologies Evaluated

##### Direct Solar Technologies for Residential and Commercial Applications

For the purposes of this study it is the physical, especially the land area requirements of the decentralized technologies that are of particular importance. It is necessary to calculate the collector area available on each site to determine whether the scenario goal can be achieved. It is equally important to identify the technologies' performance.

However, solar technologies, especially direct solar technologies, are changing rapidly. Performance of thermal collectors and supply systems is expected to improve substantially in the next 20 years. In addition, photovoltaics are expected to become economically feasible, making it possible to produce electrical as well as thermal energy on-site. On-site solar energy supply could be further increased by the use of long-term storage of thermal energy collected during the non-heating season.

Since shadows are considerably less severe in the fall than in the winter, ~~tanks of collectors could be placed closer together and surface areas shaded by vegetation or structures during the~~ <sup>could be used as collector area,</sup> increasing the amount of available collector area on a site. <sup>winter could be used as collector area,</sup>

In order to evaluate the influence of these technological advances on solar potential and community impacts, six direct solar technologies <sup>are</sup> ~~will be~~ evaluated. These six represent a likely sequence of implementation during the next 20 to 50 years. Initially, thermal collectors with a short-term thermal storage tank <sup>might</sup> ~~will~~ be installed on individual sites to provide heat and hot water, e.g., on roof tops, and over parking lots. As collector efficiencies and system technology improve and the cost of alternative fuels rises, solar systems located within a geographic area, (e.g., a block, neighborhood, or commercial center), may be integrated with a single storage capacity to increase the area's solar reliance. Increased reliance could occur as a result of the increased feasibility of long-term storage due to reduced heat losses from the single large storage volume and from the ability of individual sites to store energy, i.e., a collector deficit on one site could be provided by a surplus on another site within the same system.

Eventually, if and when photovoltaics become economically viable and the first-generation thermal collectors "wear out", photovoltaics with the ability to collect their own waste heat, i.e., to cogenerate, may be installed. If this occurs prior to the installation of shared storage, they may <sup>y</sup> simply provide energy for a single site using short-term heat storage. If photovoltaics are installed after shared thermal storage has been implemented, the photovoltaic array could replace the thermal collectors and utilize the same heat storage and distribution system.

The potential of six direct solar energy supply systems is evaluated in each residential and commercial case study. The systems vary with respect to collector characteristics, storage capacity, the scale at which

TABLE 2  
 SOLAR PENETRATING GOALS BY SOLAR ENERGY SOURCE  
 (DPR "Maximum Solar" Scenario for 2000)

	Percent of Sector End Use		
	<u>Residential</u>	<u>Commercial</u>	<u>Industrial</u>
Passive Design	6.15	2.15	0
Active thermal collectors	23.05	10.74	12.42
Photovoltaics/thermal electric	2.65	3.87	0.65
Biomass (wood or MSW)	3.52	0.45	9.23
Wind	1.15	1.61	0.26
<hr/>			
TOTAL SCENARIO GOAL	36.52	18.82	22.56
<hr/>			



the system is organized, and maximum reliance possible.

*System 1* consists of thermal collectors with efficiencies comparable to those currently in use and utilizes short-term storage. Inherent in the methodology used to determine solar reliance with short-term storage (ITC, 1976) is the assumption that in any month, the storage capacity is sufficient to allow for use of all heat collected during that month.

It is assumed that this approximates the performance of typical short-term systems with 1.5 to 2 gallons of water storage per <sup>square</sup> foot of collector area.

*System 2* consists of thermal collectors with improved efficiency and short-term storage. This assumes that system efficiencies could be increased by one-third with improvement of all system components and that, <sup>together with</sup> the use of planar reflectors, could ~~increase the collector output by 50 percent.~~ <sup>double</sup>

*System 3* consists of cogenerating photovoltaics which produce electricity at 80 percent the efficiency of current photovoltaics and heat at 80 percent of the output of current thermal collectors with short-term heat storage.

*System 4* consists of thermal collectors with current efficiencies and long-term storage in a shared system. Long-term storage capacity will vary with the needs of each situation. It is assumed that all collectable energy is collected with a 20 percent heat loss from the storage system. Long-term storage is assumed to be possible when a number of structures share the same large storage volume. An additional 20 percent heat loss is assumed to occur <sup>during</sup> ~~and~~ distribution.

*System 5* consists of thermal collectors with improved efficiency and shared long-term storage.

*System 6* consists of cogenerating photovoltaics with shared long-term heat storage.

Table 3 lists the percentage of various end use energy demands that can be provided by each system assuming that collector area is not limited. When these percentages of end-use demand are applied to a particular land use pattern, the proportion of the total energy demand that can be provided is the technology's potential.

Appendix A describes the components, physical requirements and performance of direct solar technologies.

### Direct Solar Technologies for Industrial Applications

Three solar thermal technologies are used for industrial applications: shallow ponds for low temperature applications ( $100^{\circ}\text{F}$  and  $125^{\circ}\text{F}$ ); flat plate collectors for  $150^{\circ}\text{F}$ ; and polar mounted tracking cylinder collectors for temperatures above  $150^{\circ}\text{F}$  but less than  $550^{\circ}\text{F}$ .

Appendix A characterizes the physical appearance and performance of these technologies. -.

### Wind Energy Conversion

It is assumed, for the sake of this analysis, that <sup>Wind energy conversion systems</sup> some (WECSs) will be located within the community. In the high rise commercial and high density residential sectors, turbines might be placed within the new structures. In the other land use sectors, and as an alternative in the above sectors, vertical or horizontal blade machines might be located on towers fixed to the ground. The systems evaluated are described in Appendix A.

### Biomass Conversion

To evaluate the use of biomass selected technologies are first matched to end uses. Wood burning in stoves is assumed for residential applications at an efficiency of 60 percent (Sullivan, 1978). Municipal solid waste (MSW) is assumed to be the source for commercial applications. The pyrolysis process converts waste to low Btu gas which is storable and transportable and produces fewer residuals than other MSW conversion (LBL, 1978). For these reasons it is assumed to be the process used in the case study applications. System inputs and outputs are listed in <sup>Appendix A</sup> ~~Figure 3-2-8~~. Net energy production is 0.31 Btu/pound of MSW assuming a primary fuel to electricity conversion efficiency of 31 percent.

TABLE 3

POTENTIAL OF SIX TECHNOLOGY SYSTEMS  
TO MEET ENERGY END USE DEMANDS

Technology	Short-term storage	Long-term storage
Thermal collectors with performance comparable to currently available	1. 70% heat 80% hot water 70% cooling <sup>1</sup>	4. 100% heat 100% hot water 100% cooling <sup>1</sup>
Thermal collectors with a 33 percent increase in efficiency and using planar reflectors to increase output 50 percent (50 percent reduction in collector area)	2. 70% heat 80% hot water 70% cooling <sup>1</sup>	5. 100% heat 100% hot water 100% cooling <sup>1</sup>
Cogenerating photovoltaics with 80 percent the output of current photovoltaics and 80 percent the output of current thermal collectors	3. 70% heat 80% hot water 100% cooling 100% power	6. 100% heat 100% hot water 100% cooling 100% power

## NOTES:

1. Use of solar thermal air conditioning is assumed only for the commercial sector.

## METHODOLOGY

The methodology followed in this study is summarized in a flow chart in Figure 1. This chapter will outline this methodology briefly to provide an analytic backdrop against which to consider the study's findings.

### General Data Collection

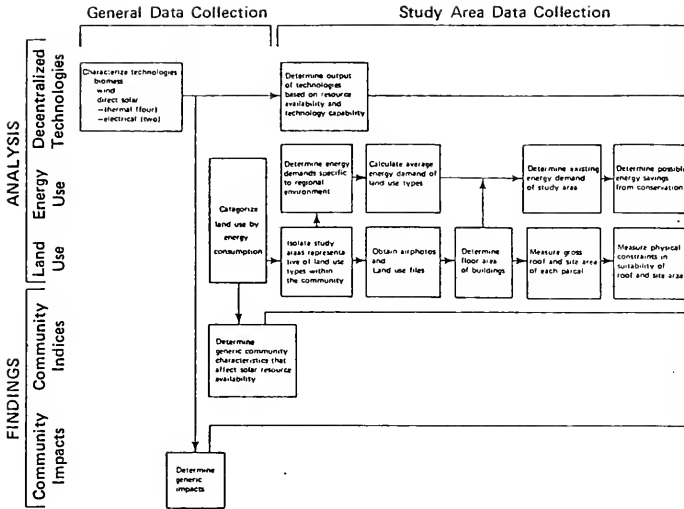
The first set of activities undertaken is described as general data collection. This included placing the DPR scenario into a community-level context, characterizing the technologies to be evaluated, and categorizing land uses into representative patterns. These activities have been described in Chapter 1. Two other major steps were: 1) a literature review and identification of generic impacts expected to occur as a result of the use of decentralized solar technologies, and 2) the identification of environmental characteristics expected to influence and be impacted by solar energy use. Chapter 4 contains a matrix of generic impacts in which those that appeared in the case study analyses are identified; Appendix C contains a detailed discussion of the generic impacts. Appendix B provides a discussion of characteristics in the natural, built and social environments which may potentially constrain solar energy use.

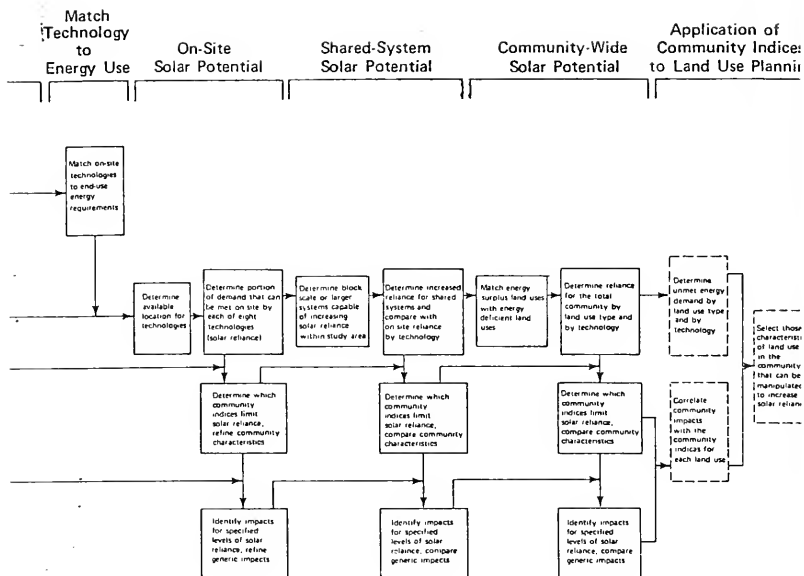
### Study Area Data Collection

Analysis of solar energy reliance constraints and impacts each study area required the compilation of three types of data: land use, energy use and technology output.

Land use data was obtained from aerial photographs and the land use files of planning departments in the case study cities. The case study areas within each city were selected with the assistance of planning personnel as examples of typical land use densities and building form within each land use pattern. Then, total surface area available on each site in the study area was measured. Next, the extent to which environmental constraints limited the <sup>usefulness</sup>~~usability~~ of that area for solar collectors was evaluated; the collector area potential of each site was recorded. (See Appendix A for assumptions regarding the spatial requirements of solar collectors).

Simultaneously <sup>with</sup> collector area evaluation, the land use data was used to determine the quality and quantity of energy demand at each site.





To estimate energy requirements of building types, a review of recent studies of energy demand of building types was conducted, focusing on those which relied on heating and cooling loads calculations or energy consumption records of representative building forms. (A.D. Little, 1977; ITC, 1976; Hittman Associates, 1973, 1974 and 1976; Westinghouse, 1974; and General Electric, 1974).

These studies reveal a wide range of findings regarding heating and cooling loads of building types. This variation may reflect differences in analytic methods and assumptions as well as actual differences among individual buildings of the same form. Construction specifications, quality of construction, energy use practices, building uses, microclimatic variations and other variables specific to a particular building influence its heating and cooling load. Furthermore, classification of building types into a manageable number of categories requires that buildings with quite different energy use patterns be lumped together.

Two primary sources provided the basis for computations of on-site energy demand. A study for the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) represented the most complete data for our purposes (A.D. Little, 1976). It provided values for total energy consumption rather than for just heating and cooling demands and identified energy savings which would result from modest conservation measures. These values were used in the commercial sector. A series of studies of space heating and cooling energy demand and conservation potential in the residential sectors of Denver and Baltimore (Hittman, 1973, 1974, and 1975) provided a useful characterization of the residential sector. The third segment of the study area analysis consisted of calculating the energy supply per square foot of collector area which could be provided by each technology in the study area's climate.

ITC (1976) provided a convenient method for determining solar reliance for space heating, domestic hot water and cooling using short-term storage. Solar supply with long term storage was determined using ASHRAE monthly clear day insolation data and an established methodology for estimating monthly collectable energy (Anderson, 1976). Assumptions regarding collector efficiencies and system losses and performance of wind and biomass technologies are listed in Appendix A. The documentation of study area analyses in Appendix D records collector performance values for each

study area.

In evaluating the proportion of total energy demand that can be met by solar technologies in the residential and commercial sectors, it is assumed that the conservation measures are initiated before solar energy technologies are installed. Conservation consisting primarily of insulation, weatherizing and double glazing in existing structures, would occur as a more economical first step in reducing centralized energy consumption (Rosenfeld, 1976).

#### Matching On-site Technologies to End-Use Energy Requirements

The next step consisted of identifying which technologies were appropriate in each land use in order to meet the scenario goal for each solar energy source. Direct solar technologies were applicable in all study areas; the six direct solar technology systems were evaluated in every commercial and residential case. Direct solar technologies were matched to the quality of process heat demands in the industrial cases. Biomass and wind energy conversion technologies were also applied selectively.

#### Analysis of On-site Solar Potential, Constraints and Impacts

Having determined the on-site area available as locations for solar technologies, the portion of each site's total energy demand which could be provided by each on-site technology, i.e. wind, wood-burning or industrial biomass conversion, and direct solar technologies with short-term storage (technologies 1, 2 and 3), was determined. This achievable level of solar reliance was then compared with the DPR scenario goal. Levels of solar reliance achieved in each study area relative to the total scenario goal are listed in Chapter 3; the analytic process is documented in Appendix D.

If any site was unable to meet the scenario goal, the environmental constraints which prevented it from doing so were identified; these are discussed in Chapter 4. When this analysis had been carried out for every site in the study area, the impacts which would result from meeting the scenario goal were evaluated. Chapter 5 contains the assessment of impacts identified in each study area.

#### Analysis of Shared Solar Potential, Constraints and Impacts

The next step consisted of determining the extent to which solar reliance could be increased within the study area by using shared direct solar systems with long-term thermal storage. Again, constraints and impacts were identified.



#### Analysis of Community-side Solar Potential, Constraints and Impacts

The final step in the analysis consisted of an evaluation of the potential of the community as a whole, composed of a typical mix of the land use patterns studied, to meet the scenario goal. The primary task was to determine whether an energy supply deficit in one study area could be offset by a surplus in other study areas. If this could be accomplished, impacts could be avoided.

## DECENTRALIZED SOLAR ENERGY SUPPLY

- Assuming a typical ~~land-use~~ mix of the land-use types studied, a community can achieve the DPR "maximum solar" goals for the year 2000 using on-site technologies with current performance. Table 3 contains the percent of total energy demand for each land-use type that can be provided by the direct solar technologies.
- Of the individual land-use types, only the commercial central business district cannot achieve the scenario goal on-site <sup>with any technology.</sup> The deficit in the central business district, however, can be more than offset by the ability of other land-use types to achieve a greater level of solar development.
- In the residential sector, low density detached single-family development (i.e. urban sprawl) is not required in order to meet the solar scenario.
- Detached single-family development can achieve greater independence from conventional energy sources than denser residential patterns only by using cogenerating photovoltaic systems with long-term storage.
- Central-city industrial locations would require use of other renewable sources (e.g. cogeneration, wood or municipal residues) in addition to direct solar technologies to meet the solar scenario.
- Decentralized solar technologies can produce substantially greater amounts of on-site energy supply than the DPR scenario projects. The increased levels are limited by the quality and availability of energy supplied by a given technology and by the demand for that particular quality of energy within each land-use sector (see Table 4).
- Communities will be required to take one or more of the following actions in order to produce increased level of on-site energy:
  - select technologies which maximize output of both thermal and electrical energy, including use of long-term storage and cogenerating systems;
  - implement shared energy systems in which a number of individual energy collectors are combined with a single storage facility;
  - transfer surplus thermal and electrical energy to land-use types deficient in on-site solar potential; and
  - control land development patterns through land-use regulations to eliminate environmental characteristics that constrain on-site collection.

The first step in this analysis of how solar energy use will impact land use and the environment was to determine whether the level of solar penetration identified in the DPR scenario could be accommodated on-site using currently available technologies in existing land use patterns. The next step was to identify the level of penetration at which land use impacts would be induced within each land use pattern, i.e. to determine the point at which characteristics of the physical form of development limit the use of these technologies.

Then, the opportunity for eliminating those impacts and increasing on-site solar energy supply using more sophisticated direct solar technologies was evaluated. Again, the point at which land use impacts would occur was evaluated for each technology.

This quantitative analysis of the six land use patterns is documented in Appendix <sup>D</sup>~~A~~. Table 4 summarizes the findings of this analysis; it provides quantitative support of the following discussions of solar energy supply and of the effect of technology selection on solar energy supply and on consequent impacts.

Table 4 lists the six direct solar technologies which were evaluated, beginning with thermal collectors currently in use. The subsequent technologies represent existing technologies which have not achieved widespread use at the present time but which are likely to be economically feasible in the next 25 years. The performance of each technology is evaluated for the five non-industrial land use patterns and is presented vertically in the table. For each technology in each study area, on-site solar supply is compared with the total scenario goal and with the potential of the technology to meet that study area's total energy demand. Performance is recorded as a percentage of total energy demand.

The supply of solar energy from a particular technology that can be used on-site is limited by the quality and availability of the energy produced and by the demand <sup>for</sup>~~on~~ that particular quality of energy within each land use sector. The proportion of various end use demands which can be provided by each technology is listed for each technology. Column B translates these end use energy supply potentials into a single percentage of the total energy demand for each land use. This value is important for two reasons.

TABLE 4

ON-SITE SOLAR ENERGY SUPPLY AS A PERCENTAGE OF TOTAL ENERGY DEMAND BY LAND USE TYPE AND TECHNOLOGY

## Percentage of Total Energy Demand

		A. Solar Scenario Goal	B. Technology Potential	Collector Location			F. Surplus or Deficit Relative to Scenario Goal
				C. Roofs	D. On-Site Open Space	E. Total On-Site	
<u>Direct Solar Technology</u> <u>and its end use</u> <u>energy supply potential</u>							
1. Thermal Collectors	SFD	37	40	40 <sup>1</sup>	NH <sup>2</sup>	40 <sup>4</sup>	+ 3
w/existing output	MFD	37	44	26	7	33	- 4
and short term storage	Strip	18	43	32	11	43	+25
(80% DHW)	CBD	18	39	3.6	0.1	3.7	-15
70% space heat	NH	18	56	56	NH	56	+38
70% cooling <sup>3</sup> )							
2. Thermal Collectors	SFD	37	40	20 <sup>5</sup>	20 <sup>5</sup>	40 <sup>5</sup>	+ 3
w/improved output	MFD	37	44	38	6	44	+ 7
and short term storage	Strip	18	43	43	NH	43	+25
(80% DHW)	CBD	18	39	7.2	0.2	7.4	-11
70% space heat	NH	18	56	56	NH	56	+38
70% cooling <sup>3</sup> )							
3. Cogenerating							
photovoltaics	SFD	37	85	40 <sup>5</sup>	20	60 <sup>5</sup>	+23
w/short term storage	MFD	37	86	44	18	62	+25
(80% DHW)	Strip	18	86	15	51	66	+68
70% space heat	CBD	18	86	6.2	0.4	6.6	-11
100% lights & power	NH	18	67	78	9	87	+69
100% cooling <sup>3</sup> )							
4. Thermal Collectors	SFD	37	55	55 <sup>5</sup>	NH	55 <sup>5</sup>	+16
w/existing output	MFD	37	66	31	15	46	+ 9
and long-term storage	Strip	18	61	27	34	61	+43
(100% DHW)	CBD	18	56	3.3	0.3	3.6	-14
100% space heat	NH	18	79	65	14	79	+61
5. Thermal Collectors	SFD	37	55	55 <sup>5</sup>	NH	55 <sup>5</sup>	+16
w/improved output	MFD	37	66	61	5	66	+29
and long-term storage	Strip	18	61	46	13	61	+43
(100% DHW)	CBD	18	56	6.7	0.4	7.1	-11
100% space heat	NH	18	79	79	NH	79	+61
100% cooling <sup>3</sup> )							
6. Cogenerating	SFD	37	100	54 <sup>5</sup>	26 <sup>5</sup>	80 <sup>5</sup>	+43
photovoltaics	MFD	37	100	66	26	92	+55
w/long-term storage	Strip	18	100	57	43	100	+82
(95-100% of total	CBD	18	100	9.7	0.4	10.1	- 7.9
demand)	NH	18	100	93	7	100	+82

1. Assumes removal of up to 35% of the tree canopy.

2. Not needed as collector area to meet technology's potential in the study area.

3. Active solar cooling is assumed to be feasible for commercial uses only.

4. Assumes removal of 15-20% of the tree canopy.

5. Assumes no removal of tree canopy.

6. 20% national goal includes provision of the following portion of land use sectors' total demand by decentralized solar technologies, i.e. direct solar, wind and biomass: residential 37%, commercial 18%, and industrial 33%.

TABLE 4 (Page 2)

NOTE: Analysis assumes that retrofit conservation measures have reduced demand to the following levels:

	HEAT LOAD (Btu/ft <sup>2</sup> /degree day)	Total end use energy demand in a 5200 heating degree day climate with 78° wet bulb and 94° dry bulb summer design conditions (°F)
Single Family Development (SFD) 8 Units/Net Acre	6.0	97,100
Multiple Family Development (MFD) 30 Units/Net Acre	5.5	65,400
Strip Commercial Development (Strip) <sup>2</sup> Floor Area Ratio <sup>1</sup> of 2.3	10.5	110,000
Central Business District (CBD) <sup>3</sup> Floor Area Ratio <sup>1</sup> of 6.7	10.5	102,100
Warehousing District (WH) Floor Area Ratio <sup>1</sup> of 4.6	5.0	53,300

1. Floor Area Ratio is the ratio of floor area to parcel area

2. Consists of 75% offices, 15% hotels, 10% retail stores

3. This value reflects a low estimate because it excludes elevators and assumes the same demand as in low-rise structures

First, a comparison of the scenario goal with the technology potential (column A with column B) indicates whether the scenario goal is matched with the maximum potential of the technology or whether a much greater solar supply could be achieved in a particular land use pattern. For currently available thermal collectors (Technology 1), the scenario goal is very close to the technology's potential in the residential sector. This means that solar technologies or passive design which can provide 80 percent of the domestic hot water and 70 percent of the space heat of a residential unit would be required in almost every residence in order to meet the scenario goal. In the commercial sector, on the other hand, the scenario goal calls for less than half the solar supply which is technically feasible using Technology 1, <sup>assuming the use of</sup> with solar air conditioning. If half of the commercial facilities operating in the year 2000 used thermal collectors to provide hot water and 70 percent of the space heating and cooling loads, the scenario could be met.

In no case does the scenario goal exceed the technology's potential. Therefore, if the scenario goal cannot be met by a technology, it is due to the fact that there is insufficient collector area on-site. Column F indicates whether or not the scenario goal can be met and whether it can be exceeded by each technology. If the scenario goal cannot be met, the physical form of the development would have to be altered in order to provide sufficient collector area or the energy demand would have to be reduced. Reducing energy demand may also require a change in the form of development. Unless energy demand can be reduced without altering the form of development, land use impacts will be incurred. Using Technology 1, both the multiple family dwelling study area and the central business district study area fail to meet the scenario goal. Consequently, in those study areas, land use impacts will occur unless energy demand is reduced or a more efficient technology is used to increase the solar energy supply without increasing collector area.

Secondly, a comparison of total on-site energy supply (column E) with the technology potential (column B) indicates whether or not land use impacts will be necessitated in order to use a technology to the greatest extent possible. If total on-site energy supply falls short of the technology's potential, collector area is limited by environmental characteristics. In order to use the technology to the greatest extent possible, <sup>1)</sup>

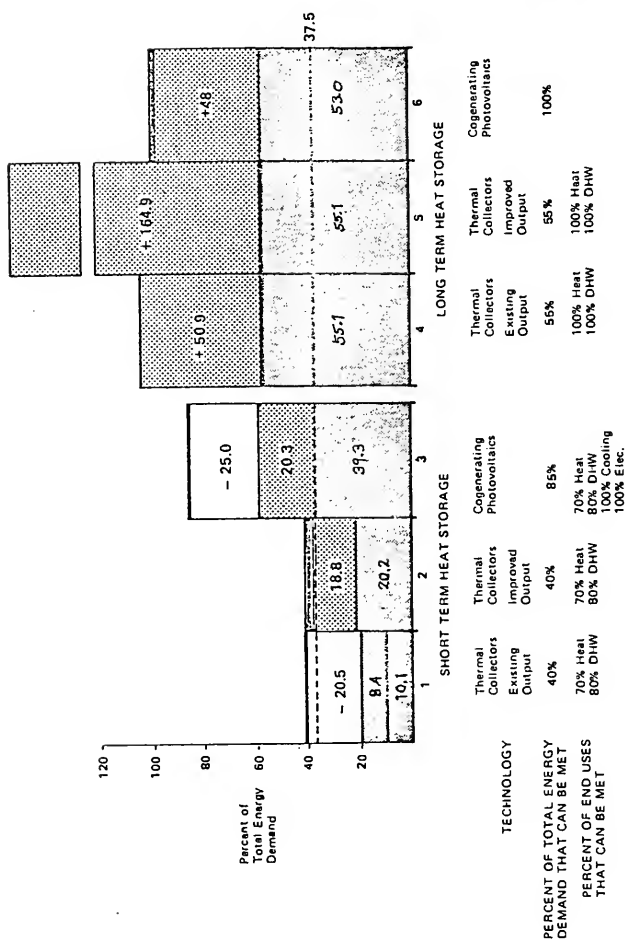
collector area would again have to be increased by altering physical characteristics of the site; or <sup>2)</sup> energy demand would have to be reduced; or <sup>3)</sup> a more efficient technology would have to be used.

Figures 2 - 7 graphically express the level of solar reliance achievable in each study area for each direct solar technology relative to <sup>but</sup> the DPR scenario goal and the technology's potential to meet the study area's energy demand. <sup>They also</sup> ~~Figures 8 - 11~~ indicate the portion of total collector area available on roof tops and on-site open space which would have to be used to meet the scenario goal and <sup>to meet</sup> the technology's potential in each study area for each direct solar technology.

#### Meeting the DPR Scenario Goal

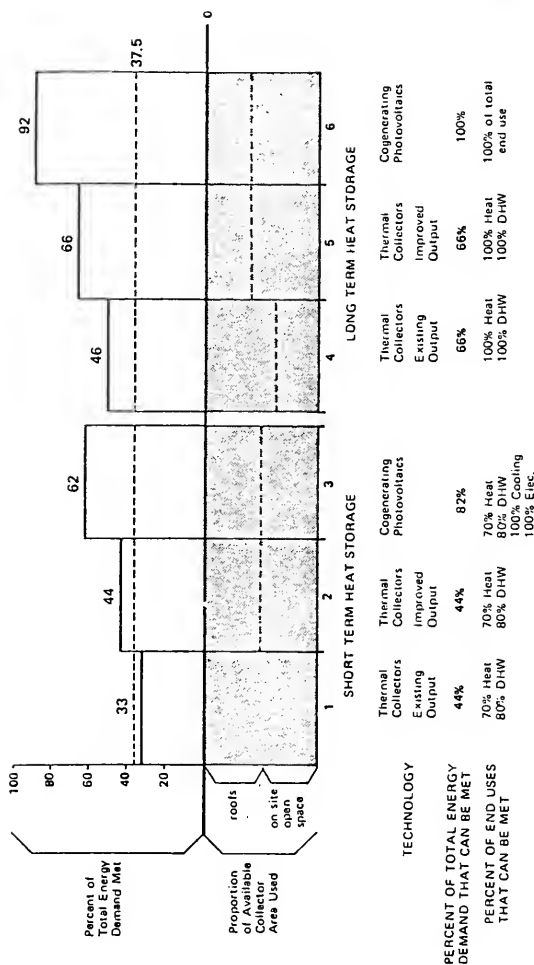
The major findings of this analysis concerning the use of solar technologies which are currently in use (Technology 1) to meet the scenario goal are as follows:

- Conservation measures alone could provide a substantial share of the DPR scenario goal in existing land use patterns. In the single family detached residential case the scenario goal for active solar technologies could be met entirely by retrofit conservation techniques (Rosenfeld, 1978). However, it was assumed that the energy demand has already been reduced by conservation measures; solar supply is evaluated as a proportion of the remaining demand. (See Appendix D for assumptions about conservation).
- A community as a whole, comprised of a typical mix of land use types (Manvel, 1968), can meet the total scenario goal on site, relying entirely on currently available flat plate or evacuated tube collectors. Within the community, however, the higher density land use patterns cannot meet the scenario goal on site. The multiple family residential case falls short of the scenario goal by 4 percent of its total demand. The central business district falls short of the scenario goal by 15 percent of its total demand (see Table 4, column f). However, the strip commercial and warehousing study areas can greatly exceed the scenario goal on site. Because they always comprise a much greater proportion of the land area of a community than the central business district, their on-site solar supplies can more than offset the central business district's deficit. Similarly, the multiple family case study's deficit can be offset by the single family case study's surplus.
- Particularly in new developments, passive solar design combined with passive or active domestic hot water heating can save as much energy as currently available thermal collectors (Balcomb, 1976). Therefore, the scenario goal can be met by passive design in new development projects and in some existing buildings.



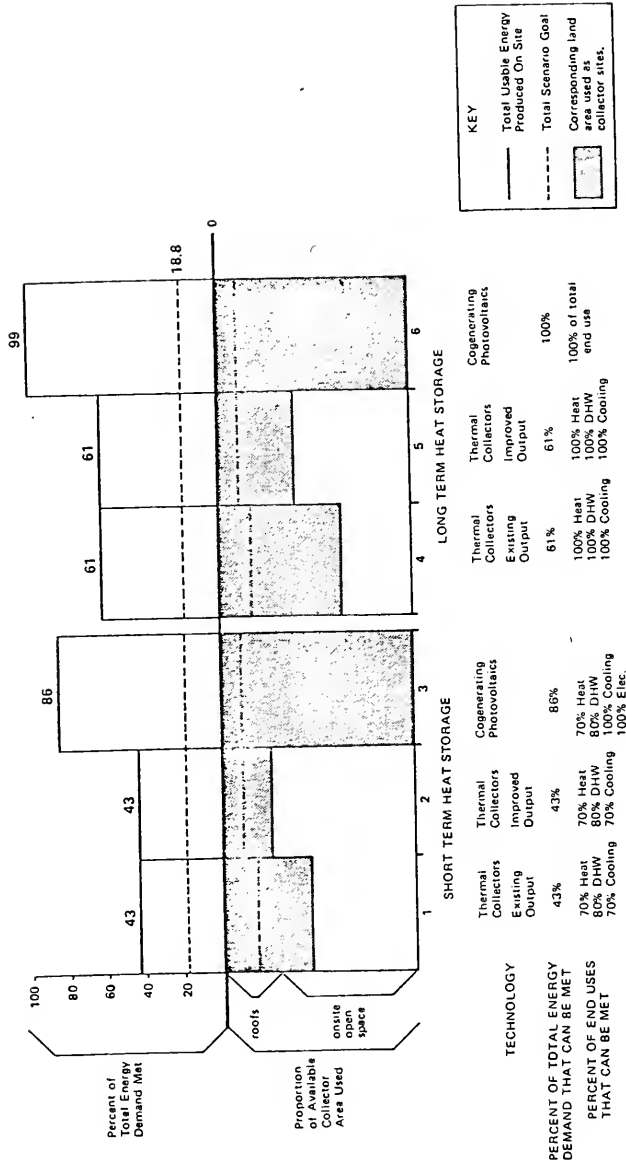
**Figure 2**



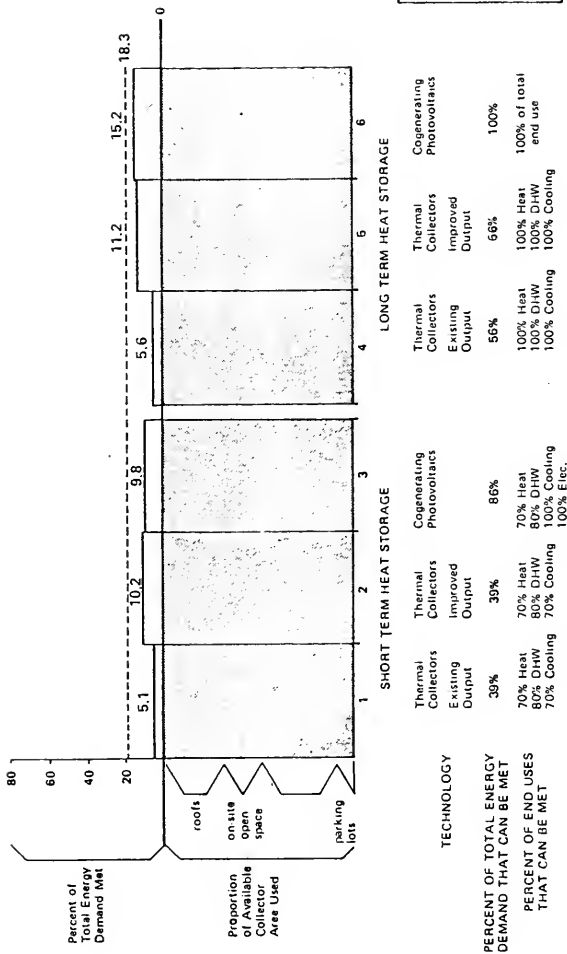


UNSHADED SITE AREA USED TO MEET SCENARIO GOAL:  
MULTIPLE FAMILY RESIDENTIAL STUDY AREA.

Figure 3

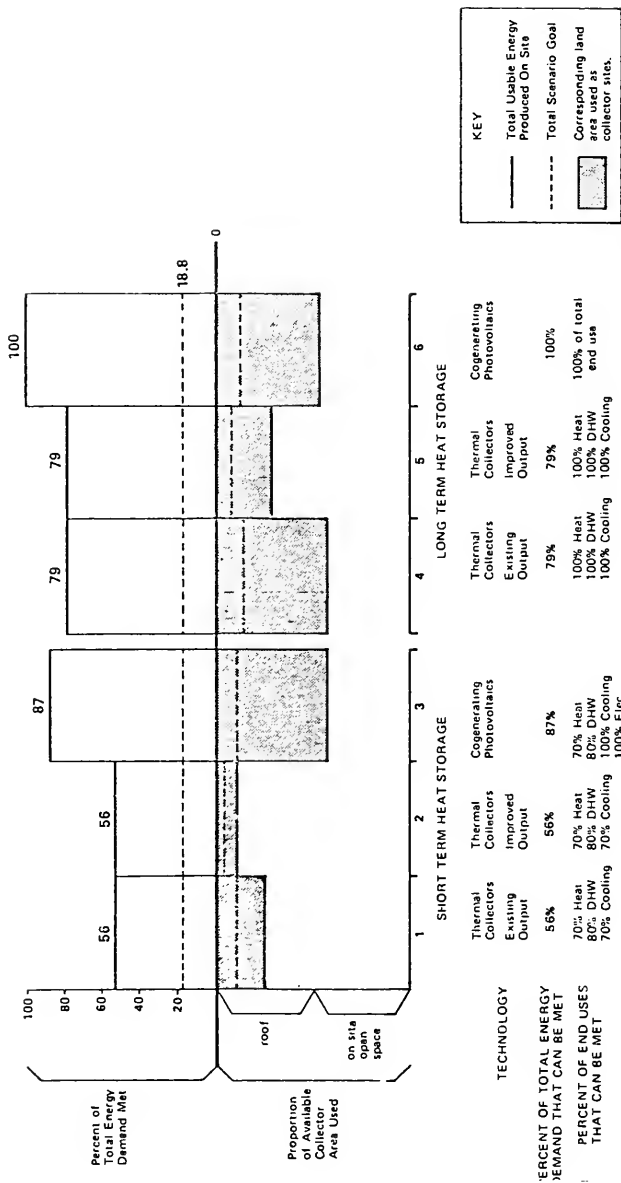


UNSHADED SITE AREA USED TO MEET SCENARIO GOAL:  
STRIP COMMERCIAL STUDY AREA.

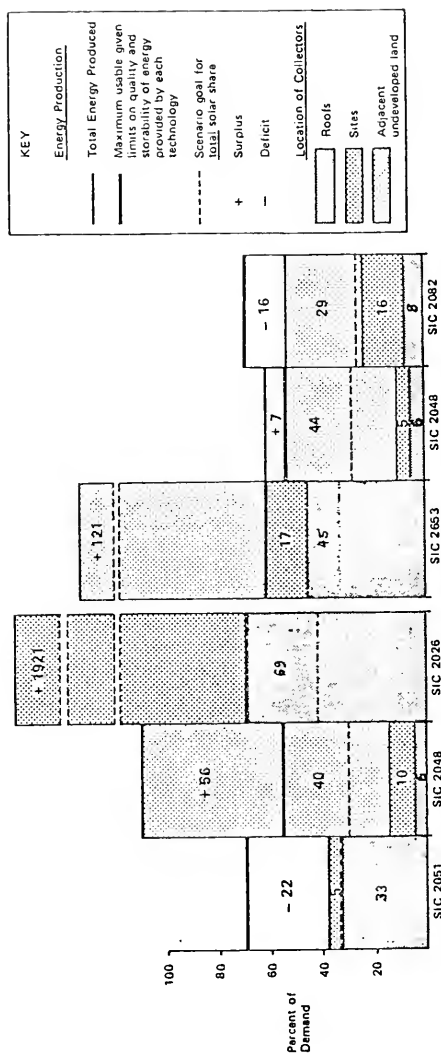


UNSHADED SITE AREA USED TO MEET SCENARIO GOAL:  
CENTRAL BUSINESS DISTRICT STUDY AREA.

Figure 5



**Figure 6**



PERCENT OF ENERGY DEMAND PROVIDED BY DIRECT SOLAR TECHNOLOGIES AT CENTRAL CITY INDUSTRIAL SITES.

Figure 7

However, significantly more changes in the physical form of development would be required to accommodate widespread use of passive design.

- In the residential sector, a shift in density and building form from predominantly single family detached to low-rise multiple family dwellings would save more on-site energy than the use of currently available thermal collectors (See Appendix D). Furthermore, the multiple family dwelling case study fell just short of meeting the scenario goal. Therefore, in a typical community which consists primarily of low density single family detached development, increased density in the form of low-rise multiple units or attached townhouses, together with the use of solar technologies or passive design can save substantially more energy than the use of solar energy alone.
- In the industrial sector direct solar technologies can meet the scenario goal in three of the six central city cases examined on the site itself and in all six cases if adjacent undeveloped land is utilized. Suburban industrial sites contain about 2.5 times as much land area as central city sites. Therefore, it appears that the total industrial sector could meet the scenario goal on-site in more than half the cases.
- In central city industrial locations, other renewable energy sources, e.g. cogeneration and agricultural or forestry residues, would be required to meet the scenario goal on-site.
- In the community as a whole, indirect solar technologies, i.e. wind and biomass, can be used selectively to minimize impacts since direct solar technologies alone can provide the total scenario goal. For example, electricity generated by wind machines located near the community may be sent to the central business district, avoiding the need to alter that land use pattern and minimizing potential impacts of wind machines located within the community.

#### Increasing Solar Energy Supply through Technology Selection

Land use and environmental impacts can be avoided to a certain extent by using technologies which provide more usable energy without increasing the collector area requirement, i.e., more efficient collectors and long-term storage. In addition, on-site solar supply can be increased by using technologies which produce electricity as well as heat, i.e. cogenerating photovoltaics. A choice of technologies gives the community as a whole more flexibility in meeting the scenario goal and, therefore will produce fewer impacts. For example, instead of using thermal collectors with short-term storage on all residences,

passive design and/or co-generating photovoltaics could be used on less than half of them to meet the scenario goal.

Column B in Table 4 indicates how the potential of the technology increases with each of the more sophisticated technologies. Column E indicates that proportion of total demand in each land use that can be provided by each technology. The following conclusions about the ability of various technologies to increase on-site solar energy supply can be made on the basis of the analysis summarized in Table 4.

- The scenario goal can be greatly exceeded in the lower density commercial land uses without using more sophisticated technologies, assuming that solar air conditioning is used.
- The scenario goal, which was not achieved in the multiple family dwelling study area using Technology 1, can be exceeded if any of the other technologies are used.
- To exceed the scenario goal to a significant degree in the residential sector, it is necessary to use co-generating photovoltaics (Technology 3 or 6) or thermal collectors which are both more efficient and employ long-term storage (Technology 5).
- Long-term thermal storage enables all study areas except the central business district to provide 100 percent of the domestic hot water demand and 100 percent of the space heating demand. Solar air conditioning or the use of the thermal storage facility for chilled water storage during the summer would reduce the summer cooling demand, especially during peak load periods. Thus, long-term storage can mitigate the adverse impact on the electrical grid that widespread use of thermal collectors with short-term heat storage is expected to cause.
- Because the per-unit energy demand of the multiple family study area is smaller than that of the single family study area, use of all the solar technologies considered enables the multiple family study area to use less fossil fuel-derived and/or centralized energy than the single family study area. An analysis of six hypothetical residential land use patterns based on the case study analyses indicates that detached single family houses at a density of 8 dwelling units per acre can reduce their remaining energy demand to less than that of high-rise apartments and row-houses at a density of 24 to 30 dwelling units per net acre only with the use of co-generating photovoltaics and long term-storage or passive design plus photovoltaics. (See Appendix D).
- The central business district fails to meet the total scenario goal on site with all of the technologies evaluated. Thermal and electrical energy could be transported from the warehousing study area which has a substantial surplus of collector area.
- If co-generating photovoltaics were available, all portions of the city, except high rise commercial and residential areas, i.e. the central business district, could meet more than 90 percent of their total energy demand on-site without altering existing land use patterns, building form or energy demand.

## ENVIRONMENTAL CHARACTERISTICS AS LIMITS ON SOLAR SUPPLY

- Environmental characteristics of a community which reduce available collector area include:
  - vegetation
  - street orientation
  - lot configuration
  - density
  - roof configuration
  - adjacent buildings
- Environmental characteristics of a community which acted as limiting factors can be eliminated by use of shared energy supply systems and long-term storage (Table 5). *in many cases*
- Environmental characteristics of the community limit on-site collectors primarily in the higher density land-use types (i.e. multiple family residential and central business district).

The level of solar supply possibly using each of the six direct solar systems analyzed is ultimately limited by the energy demand characteristics of a particular land use and the characteristics of the technology itself: the conversion efficiency of the collector, the quality of energy provided, e.g., low temperature heat for thermal collectors, <sup>and</sup> ~~at~~ the amount of energy that can be stored for use during sunless periods. As the previous discussion has shown, achieving the technologies' potential may be constrained by the area available for collector location. Whether land area is available and whether it is usable as a collector location is influenced by the characteristics of the particular environment in which the technologies are applied. The kinds of environmental characteristics that can reduce solar supply have been categorized into three types: natural, built, and social. In each category the specific characteristics are:

## 1. Natural:

- latitude
- climate
- topography
- obstruction of solar access by vegetation



## 2. Built:

- roof configuration: area and orientation
- obstruction of solar access by buildings: spacing of structures
- obstruction of solar access by buildings: variation in height and spacing
- street pattern: orientation relative to north
- street pattern: parcel configuration
- intensity of development: ratio of energy demand to unit floor area and to parcel area  
of Accra area

## 3. Social:

- community identity
- community interaction
- activity patterns

The potential solar energy supply which can be provided by each of the six technology systems in each of the land use types has been evaluated in the preceding chapters. This chapter looks to the performance of decentralized solar technologies to see which environmental characteristics actually constrained the level of solar supply achievable.

In Table 5 energy systems, defined by storage capacity and whether they are individual or shared systems, are evaluated within a series of broadening collector areas domains. The domains range from a passive south wall of an individual structure to energy import zones outside the study area. This classification permits the assessment of the location and significance of limiting environmental characteristics. If an environmental characteristic, e.g. vegetation shading, contributed to a reduction in solar supply from the maximum possible for any one of the technologies in a particular collector area domain, e.g. roof tops, the effect is identified as a "limiting factor." An assessment of limiting factors would permit a community to evaluate the effectiveness of changes in its existing environment to increase potential solar supply on-site and their appropriateness within various land use patterns.

No attempt was made at this point to rank the limiting factors. In some cases several environmental characteristics contribute to a reduction in supply potential and this analysis does not sort out the relative importance of each one.

#### Natural Environmental Characteristics

- Climate and latitude are basic determinants of solar reliance, influencing energy demand, solar energy supply and the severity of shading as a constraint. In the case studies these variables were

held relatively constant in order to focus on variations between land uses so their influence does not appear in the analysis.

- The urbanized areas examined in the case studies are relatively flat. Therefore, though topography is potentially important, it is not in the cases examined.

*significant*

- However, obstruction of solar access by vegetation did appear as a significant environmental limit with individual systems using short-term storage. Tree shading reduced the solar potential of the single family dwelling case. The scenario goal could be met with Technology 1 - currently available thermal collectors with short-term thermal storage - only if 35 percent of the existing tree canopy were removed. Vegetation shading was not a limiting factor in any land use type where long-term storage was assumed. Vegetation shading would limit the potential of passive design in three land use types: the single family dwellings, the strip commercial, and the central business district.

#### Built Environmental Characteristics

- Roof configuration was a limiting factor only in the single family dwelling case where collectors are mounted on roofs which slope in several directions. Roof configuration could potentially limit solar supply in other residential and commercial cases where flat roofs do not predominate, but such examples were not included in the case studies.

- The location of the building on the parcel (the setbacks from property limits) and the height of the building influence the amount of shading of potential on-site collector locations. On-site open space may be shaded by the building located on that site or the building itself and the on-site open space <sup>may be shaded</sup> by another building. Shading as a result of height and siting of a single structure on a parcel limited the on-site solar supply only in the single family dwelling and multiple family dwelling cases. Changes in height or location on the parcel could increase the on-site solar supply in these two land use types.

Obstruction of solar access by adjacent buildings is a limiting environmental characteristic primarily in the high density land uses. This interaction among buildings was especially strong in the central business district where it was a limiting factor throughout the study area. In these dense land use patterns, controls on height and building setbacks would have to be applied over ~~a larger~~ <sup>the entire</sup> area in order to increase on-site solar supply substantially.

- The orientation of the street pattern was a limiting factor <sup>for</sup> with every technology system in the central business district. In the CBD case, the street pattern is at 45 degrees from true north and the resulting roofs are less easily fitted with collectors. This limiting factor, however, was not the only one affecting the high density CBD. It reduced the on-site solar energy supply by about twenty percent. In other land use types, where street orientation did not deviate from true north, the patterns of streets limited only the use of south walls for passive design applications. This was particularly significant in the single family dwelling case study.

- The configuration of the lot, i.e. its dimensions or proportions was only a limiting factor for passive design implementation in the residential land uses. In the multiple family dwelling case, the narrow lot width limited passive design opportunities significantly.
- The intensity of development, results from a combination of energy intensity and net or on-site land use density, i.e. <sup>the</sup> ratio of energy demand to floor area and the ratio of floor area to parcel area. Intensity of development can constitute the baseline limit on solar supply: if there is simply not enough area on-site to produce the energy that is needed, then either the energy demand must be reduced or site area increased to accomodate more collectors.

### Social Environmental Characteristics

No specific measures were developed in this investigation to assess the social constraints on the implementation of decentralized solar technologies. Several of the energy supply systems analyzed, however, assume sharing of storage and collectors among users. Shared systems and energy importation from outside a study area implies some institutional management. Some social interaction is required in these systems.

Shared systems are most likely to be used when long-term storage is employed. Therefore, social constraints are expected to occur with technologies requiring long-term storage. However, <sup>for</sup> with all technologies in multiple family dwellings, social constraints are likely to arise since more than one family shares the same parcel of land and <sup>roof</sup> ~~net~~ area and is likely to share the components of the solar energy systems.

### Overcoming Environmental Limits

Environmental characteristics do limit the solar potential of decentralized technologies. The limits do not apply equally to each land use sector nor to each technology. Many of the characteristics identified in the analysis can be manipulated to increase solar supply. Results of such manipulation would be specific to both particular technologies and land use sectors. For example, active solar energy use is limited primarily by tree shading for single family dwellings. Passive design, on the other hand, must effectively deal with vegetation, street pattern (including orientation and lot configuration), development intensity, and height and setback limits.

In general, the effects of any one modification to the environment, natural, built, or social, will yield greater solar supplies in only specific land use sectors using particular technologies. No change in environmental characteristics will yield the same result in every land use sector.

Consequently controlling a specific environmental characteristic e.g. changing setbacks from property lines, instituting height controls, or establishing the orientation of new streets and the proportions of new parcels, may not increase the potential for on-site solar energy production throughout the community. <sup>A community must</sup> ~~Some attempt must be made to~~ either rank characteristics <sup>according to their significance</sup> ~~in order to learn which are the most significant~~ in various land use patterns <sup>in order to control only the most important ones</sup> or control all those characteristics that can reduce potential supply <sup>A</sup> ~~in all land uses.~~

Environmental characteristics will limit the use of passive design techniques more significantly than they will limit the use of active solar technologies. When economics are taken into account, passive design is likely to be the most viable solar technology, particularly in the case of new development. However, passive design was deemphasized in this analysis of the adaptability of existing land use patterns to solar energy use. A complete assessment of land use impacts would require the application of this analysis of environmental constraints to the use of passive design techniques.

TABLE 5  
ENVIRONMENTAL CHARACTERISTICS AS LIMITING  
FACTORS ON SOLAR SUPPLY<sup>1</sup>

	Energy Supply System Characteristics*					
	Individual/ Short-Term Storage			Shared/ Long-Term Storage		
	Passive So. Wall	Roof	Roof <sup>2</sup> Site	(Parcels) Block	Study Area	Beyond Study Area
Latitude						
Climate						
Topography						
Obstruction of solar access by vegetation	SFD Strip CBD	SFD	SFD			
Roof Configuration: area and orientation		SFD				
Obstruction of solar access by buildings: spacing of structures	SFD		MFD Strip			
Obstruction of solar access by buildings: variation in height and spacing	SFD MFD Strip CBD	MFD CBD	MFD CBD	CBD	CBD	
Street pattern: orientation relative to north	SFD WH CBD	CBD	CBD	CBD	CBD	
Street pattern: parcel configuration	SFD MFD					
Intensity of develop- ment: energy demand/ floor area/parcel area	SFD CBD	MFD CBD	MFD CBD	CBD	CBD	

SFD: Single Family Dwelling (detached)

MFD: Multiple Family Dwelling

Strip: Strip Commercial Development

WH: Warehousing

CBD: Central Business District

1. Environmental characteristic is a limiting factor when it reduces the solar technology below the theoretical potential.
2. Site: Area on parcel not occupied by structures.

## LAND USE AND ENVIRONMENTAL IMPACTS OF DECENTRALIZED SOLAR ENERGY USE

- Demand for water to meet thermal storage requirements although an impact with each technology is insignificant relative to total water consumption within the community.
- Potentially significant secondary impacts may occur from the disposal of hazardous wastes associated with the working fluids.
- Visual intrusion of solar collectors will be more significant in the central business district, central-city industrial locations, and in high density residential areas than in low density commercial or residential types.
- Meeting the scenario goal in the single-family dwelling case, using on-site thermal collectors, will require the removal of 15-35 percent of the tree canopy.

The primary purpose of this study was to identify impacts which are expected to occur within a community as a result of implementing the DPR scenario. Having determined the potential for on-site solar energy production and identified environmental characteristics which limit that supply, it is now possible to identify impacts.

The impact analysis has been summarized in the form of an impact matrix, Figure ~~1~~<sup>8</sup>. The matrix identifies those impacts which would result from the use of currently available solar technologies to meet the DPR scenario goal for each solar energy source, i. e. passive design, direct solar conversion to heat and electricity, and wind and biomass conversion. Thermal energy collection assumes the use of short-term thermal storage and currently available system components, i.e. Technology 1 of the six evaluated. The matrix evaluates impacts (rows) by solar energy source and scale of the supply system, i.e. on-site, shared and centralized within the community (columns). Impacts are classified into eight categories based on those identified in an initial literature review and generic analysis of impacts:

1. Land use impacts
2. Water use
3. Ecological impacts, both terrestrial and aquatic
4. Safety
5. Impacts on the community service infrastructure
6. Visual impacts
7. Noise
8. Water and air pollution

This classification provided a framework for assessing impacts in the case study analyses. For a more detailed discussion of impacts, see

## Appendix D.

The evaluation of impacts in the matrix indicates: 1. whether or not each impact was evaluated specifically in the case study analyses, 2. if evaluated, whether or not it was found to be an impact, and 3. if not evaluated, whether it is an impact which is generally expected to accompany the use of the technology or whether it is likely to occur only in a specific set of circumstances, i.e. is improbable. Those impacts which are expected to occur based on the case study analyses are discussed briefly following the matrix.

In the case study analysis of impacts it was assumed that technologies would be located first on individual sites. Then, if the scenario goal could not be met on each site on an individual basis, shared systems would be employed. If the scenario goal still could not be met, large-scale systems centralized within or proximate to the community would be used. Therefore, if the scenario goal can be met using on-site systems, the matrix will indicate that no impact will result at the shared and centralized levels.

The impacts encountered in the analysis have been divided into two major categories: land use impacts and environmental impacts. Land use impacts were found to be more significant, potentially requiring pre-emption of vacant parcels as collector locations; multiple use of open space, e.g. parking lots, on developed parcels; and the transfer of energy within the community from one land use to another for existing buildings; and changes in the arrangement, spacing, orientation and form of new buildings.

Environmental impacts will occur as a result of the use of direct solar technologies, but none appears to be significant relative to impacts which already occur as a result of physical development in urban and sub-urban environments. Removal of vegetation to preserve solar access to on-site collectors is a primary impact in the low density residential and use pattern.

Environmental impacts of wind machines located on-site are more significant, with safety, noise and interference with television reception as the primary concerns. Since electrical energy is easily transported via the existing grid, siting of wind energy conversion machines in areas removed from the energy users, either within or near a community, is a feasible mitigation measure which would eliminate all of these impacts on

COMMUNITY LEVEL  
IMPACTS MATRIX p.1

	PASSIVE	THERMAL			PHOTOVOLTAIC			WIND			BIOMASS		
		Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central
LAND USE PREEMPTION													
On Developed Site													
Roof Areas		■	■		■			■					
roof top gardens		■	■		■			■					
signs or billboards		■	■		■			■					
rooftop water collector		■	■		■			■					
Side Yards		■	■					■	■				
Back Yards		■	■					■	■				
Entry Yards		■	■					■	■				
Parking Lots		■	■					■	■				
Entire Parcels													
Parks			▲						▲				
vest pocket parks			▲						▲				
community gardens			▲						▲				
community parks			▲						▲		▲	▲	
regional parks			▲	▲					▲	▲	▲	▲	
state/federal parks			▲	▲					▲	▲	▲	▲	
Other Recreation			▲	▲					▲	▲	▲	▲	
commercial campgrounds			▲	▲					▲	▲	▲	▲	
golf course			▲	▲					▲	▲	▲	▲	
miniature/pitch-putt			▲	▲					▲	▲	▲	▲	
riding areas			▲	▲					▲	▲	▲	▲	
hunting areas			▲	▲					▲	▲	▲	▲	
birding areas			▲	▲					▲	▲	▲	▲	
public shorelines			▲	▲					▲	▲	▲	▲	
ecological reserves			▲	▲					▲	▲	▲	▲	
marinas			▲	▲					▲	▲	▲	▲	
motocross areas			▲	▲					▲	▲	▲	▲	
sports areas			▲	▲					▲	▲	▲	▲	
race tracks			▲	▲					▲	▲	▲	▲	
concert pavilions			▲	▲					▲	▲	▲	▲	

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Figure 8



## IMPACT MATRIX CONT. p.2

	PASSIVE	THERMAL			PHOTOVOLTAIC			WIND			BIO MASS		
		Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central
Residential Uses													
single family detached		▲	▲	▲	▲	▲	▲	■	▲				
multiple family		▲	▲	▲	▲	▲	▲	■	▲				
apartment		▲	▲	▲	▲	▲	▲	■	▲				
Commercial/Industry													
fruit drying		▲		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
stock yards		▲		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
storage yards		▲		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
warehouses		▲		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
greenhouses		▲		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
nurseries		▲		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
vacant parcels		■	○	▲	▲	▲	▲	■	■	▲	▲	▲	■
Public Facilities													
airports				▲		▲	▲		▲	▲		▲	▲
shipping ports				▲		▲	▲		▲	▲		▲	▲
cemeteries	■			▲		▲	▲		▲	▲		▲	▲
parking lots	■	■	○	▲		▲	▲		▲	▲		▲	▲
street intersection	■			▲		▲	▲		▲	▲		▲	▲
utility easements	■	■	○	▲		▲	▲		▲	▲		▲	▲
railroad r.o.w.	■	■	○		▲	▲		▲	▲		▲	▲	▲
Resource Production/Extraction													
agriculture			▲	▲		▲	▲		▲	▲		○	○
grains			▲	▲		▲	▲		▲	▲		○	○
orchards			▲	▲		▲	▲		▲	▲		○	○
row crops			▲	▲		▲	▲		▲	▲		○	○
cash crops			▲	▲		▲	▲		▲	▲		○	○
forestry													
monoculture			▲	▲		▲	▲		▲	▲		○	○
other forests			▲	▲		▲	▲		▲	▲		○	○

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## IMPACTS MATRIX CONT. p.3

	PASSIVE	THERMAL			PHOTOVOLTAIC			WIND			BIOMASS		
		Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central
mining													
open pit												○	○
deep shaft												○	○
WATER USE													
Storage Medium or in Process		■	■	▲							■	■	■
Pre-emption of Alternate Use		▲	▲	▲							△	△	△
ECOLOGICAL													
Terrestrial Impacts													
Direct Toxic Impacts on Organisms													
heavy metals													
chlorinated hydrocarbons		△	△	▲									
other petroleum products		△	△	▲									
Increased soil salinity				▲			▲						△
loss of foliage				▲			▲						△
plant nutrients													
nitrate/nitrites/phosphates													
arsenic compounds					△	△	▲			△		△	△
ground compaction				▲			▲	△	△	△		△	△
Sublethal Toxic Impacts													
stunting of growth		△	△	▲	△	△	▲					△	△
change in reproductive capacity		△	△	▲	△	△	▲					△	△
changes in survival rates		△	△	▲	△	△	▲					△	△
changes in mutation rates		△	△	▲	△	△	▲					△	△
morphological deformity		△	△	▲	△	△	▲					△	△
Interference with Plant/Animal Population													
Interference with migration routes				▲			▲						
birds tangled in overhead wires				▲			▲			△			
birds tangled in blades								○	○	○			
electromagnetic interference with navigation							▲						
glare nuisance	○	○	○	▲	○	○	▲						
vegetation removal	■	■	■	▲	■	■	▲	○	○	○	○	○	○

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## IMPACT MATRIX CONT. p.4

	PASSIVE	THERMAL			PHOTOVOLTAIC			WIND			BIOMASS		
		Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central
Ecosystem Level Perturbation													
loss of diversity	○	○	○	▲		○	▲	○	○	○	○	○	○
monoculture													
habitat destruction through vegetation removal	○	○	○	▲		○	▲	○	○	○	○	○	○
alteration of succession rates				▲		▲							
change in primary productivity	○	○	○	▲		○	▲	○	○	○	○	○	○
food web magnification													
Aquatic/Marine Impacts													
Direct Toxic Impacts													
heavy metals					△	△	▲						
chlorinated hydrocarbons		△	△	▲									
other petroleum products		△	△	▲									
salinity		△	△	▲	△	△	▲						
pH		△	△	▲	△	△	▲			△			
plant nutrients						▲							
nitrates/nitrites/phosphates					△	△	▲					△	△
temperature													
Sublethal Impacts													
stunting of growth		△	△	▲	△	△	▲					△	△
changes in reproductive capacity		△	△	▲	△	△	▲					△	△
change in survival rates		△	△	▲	△	△	▲					△	△
change in mutation rates		△	△	▲	△	△	▲					△	△
morphological deformities		△	△	▲	△	△	▲					△	△
Ecosystem Level Perturbations													
change in pH of Salinity causing secondary impacts		△	△	▲	△	△	▲						
nutrient enrichment causing eutrophication and fish kills												△	△
low temperature fluid causing secondary impacts													
loss of diversity		△	△	▲	△	△	▲						

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## IMPACT MATRIX CONT. p.5

	PASSIVE	THERMAL			PHOTOVOLTAIC			WIND			BIOMASS		
		Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central
SAFETY													
Personal Safety													
Installation		△	△	▲	△	△	▲	△	△	△	△	△	△
falls		△	△	▲	△	△	▲	△	△	△			
Operation													
toxic substances													
eutectic salts		△	△	△									
petroleum oils		△	△	△									
working fluid additives		△	△	△									
gallium arsenide					△	△	▲						
toxic gasses					○	○	▲	△	△	△	○	○	
disease vectors		△	△	▲							○	○	
burns													
heat		△	△	▲	△	△	▲				△	△	△
chemical					△	△	▲	△	△				
flying objects													
blade throw								△	△	△			
cuts		△	△	▲	△	△	▲				△	△	△
glass breakage													
access													
compliance of emergency egress													
falls													
glare		△	△	△	▲	△	△	▲					
Maintenance													
burns		△	△	△	▲								
cuts		△	△	△	▲	△	△	▲	△	△	△		
glass breakage													
falls		△	△	△	▲	△	△	▲	△	△	△	△	△
Building Safety													
Installation		○	○	▲	○	○	▲	○	○	○			
excessive weight		○	○	▲	○	○	▲	○	○	○			
operation		○	○	▲									
leaks		○	○	▲									

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## IMPACT MATRIX CONT. p.6

	PASSIVE	THERMAL			PHOTOVOLTAIC			WIND			BIO-MASS		
		Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central
INTRASTRUCTURE													
Interference with Underground Facilities													
storm drains		△	○	▲	△								
water supply		△	○	▲	△								
sewer systems													
conventional		△	○	▲	△								
septic tank		△	○	▲	△								
other sewage treatment		△	○	▲	△								
gas		△	○	▲	△								
electric		△	○	▲	△								
steam		△	○	▲	△								
telephone		△	○	▲	△								
cable television		△	○	▲	△								
Relationship to Power Grid		△	○	▲	△								
maintaining grid for back-up	○	○	○	▲	○	○	▲	○	○	○	○	○	○
scale problems					△	▲	▲			▲	▲		
Service Capacity													
water supply		☒	☒	▲	☒	☒	▲				☒	☒	☒
sewer capacity												▲	▲
transit													
trucking												○	○
rail												○	○
shipping												○	○
traffic congestion												○	○
Accessibility													
preemption of public easements													
restricted access to open space land													

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## IMPACT MATRIX CONT. p.7

	PASSIVE	THERMAL			PHOTOVOLTAIC			WIND			BIOMASS		
		Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central
VISUAL													
Conflicts with Surrounding Architecture/Environ													
scale	▲	■	■	▲	■	▲	▲	■	▲	▲		▲	▲
bulk	▲	■	■	▲	■	▲	▲	■	▲	▲		▲	▲
color	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲		▲	▲
texture	▲	■	■	▲	■	■	▲	▲	▲	▲		▲	▲
form	▲	▲	■	▲	■	■	▲	■	▲	▲		▲	▲
other imposition on natural features		▲	▲	▲	▲	▲	▲	▲	▲	▲		▲	▲
glare or reflectivity	■	■	■	▲	■	■	▲						
blockage of view	■	■	■	▲	■	■	▲	△	△	△			
NOISE													
Transmission Line Hum				▲			▲	■	■	▲			
Rotor Blade Vibration													
Water Heating Hum													
Traffic Noise												○	○
Mechanical Noise												○	○
POLLUTION													
Water Pollution													
potable water													
chlorinated hydrocarbons		△	△	▲									
other petroleum products		△	△	▲									
synthetic organics		△	△	▲									
other oxygen demanding wastes													
plant nutrients													
nitrates/nitrites												△	△
Phosphates												△	△
other inorganics													
chromates/dichromates													
disease/allergy causing agents		○	○	○									
heat		○	○	○									
radioactive material													

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## IMPACT MATRIX CONT. p.8

	PASSIVE	THERMAL			PHOTOVOLTAIC			WIND			BIOMASS		
		Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central	Onsite	Shared	Central
sediment													
metallic compounds		○	○	▲									
stream and groundwater													
chlorinated hydrocarbons		△	△	▲									
other petroleum products		△	△	▲									
synthetic organics		△	△	▲									
other oxygen demanding wastes												○	○
plant nutrients												○	○
nitrites/nitrates												○	○
phosphates												○	○
other inorganics													
chromates/dichromates													
disease/allergy causing agents		○	○	▲								○	○
heat		○	○	▲									
radioactive material													
sediment				▲			▲	○	○	○			○
metallic compounds												○	○
Air Pollution													
hydrocarbons												○	○
oxides (NOx, SOx, COx)												○	○
ozone												○	○
water vapor												○	○
halogens													
hydrofluoric		○	○	▲									
fluoride		○	○	▲									
chloride		○	○	▲									
arsenic					○	○	▲						
particulates		○										○	○
odor causing agents		○										○	○

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the community.

Environmental impacts of biomass conversion facilities are the most significant. The irreversible commitment of resources, air and water quality degradation and water consumption are the major impacts.

#### Land Use Impacts

Table 6 identifies those decentralized solar technologies which would produce land use impacts in six land use types analyzed in the case studies. A distinction is made between those instances where land use impacts would result from producing enough solar energy to meet the scenario goal (DPR goal), and where impacts would result from producing the maximum amount of solar energy that could be used in a particular land use (the technology's potential). Since the DPR goal is lower than the technology potential, particularly in the commercial sector, substantially fewer land use impacts will result from meeting the scenario goal than from using direct solar technologies to the greatest extent possible.

In addition, more efficient direct solar technologies will produce fewer land use impacts than those with current levels of performance. If more efficient technologies (requiring a greater capital outlay) are available, it is usually possible to select one which will minimize land use impacts.

Meeting the scenario goal will produce the most land use impacts in the central business district where a combination of high energy demand and dense development pattern make the implementation of on-site direct solar technologies the most difficult.

#### Land Use Pre-emption or Multiple Use

The most common kind of land use pre-emption that would result from achieving the scenario goal--one that appears with many direct solar technologies--is the installation of collectors in open areas on the development site. This impact is labelled "multiple-use" and indicates that the existing use need not be displaced, only modified. Examples are the installation of collectors on raised backyard trellises in the residential sector or on raised structures in parking lots in the commercial sector.

Through the case studies were designed to distinguish between impacts within the study area and impacts outside the study area, impacts are nearly always confined to neighborhoods of similar land use development within the community. To meet the scenario goal only the central business district's



high energy demand would require the collection of energy somewhere else in the community. In no case was it found to be necessary to eliminate an existing land use in order to permit the collection of on-site solar energy either to meet the scenario goal or even the more ambitious technology potential.

The pre-emption of vacant parcels would be required for the ~~MSW~~ <sup>of a MSW conversion facility</sup> installation, to meet the biomass goal in the commercial sector. But since this use is an industrial one, <sup>the</sup> ~~whose~~ economic merits <sup>of which</sup> must include the market price of the site, this land use impact would not necessarily adversely affect the community. The only potential for pre-emption of vacant parcels to meet the scenario goals for the remaining technologies is in the central business district.

In the industrial land use cases, technologies were selected to meet particular process heat requirements. These technologies were not the same <sup>ones</sup> used in the other case studies and include ~~X~~ solar ponds, flat plate collectors, and parabolic trough collectors. The analysis indicates that using these technologies to meet the scenario goal would require multiple-use of on-site open space in three of the six central city industrial sites evaluated and use <sup>of</sup> vacant parcels in three of six sites, but would not require any change in existing use. Suburban industrial sites, not analyzed in this study, are typically located on parcels 2.5 times larger than the central city sites analyzed (Boykin, 1975). With this amount of usable collector area on the parcel, it is expected that land use impacts would be comparably reduced.

Use of cogeneration techniques, which was not evaluated in this study, could significantly mitigate the land use impacts of on-site solar energy production in central city locations.

#### Changes in the Form of Land Use

A second category of land use impacts results from changes in the form of development necessary to accommodate solar technologies on-site. These impacts are expected to occur in new development that is designed to specifically accommodate on-site energy production.

Those technologies that induce these changes in the various land use sectors of a community are indicated in the key to Table 6. A distinction is made between impacts that results from meeting the scenario goal and ~~the~~ <sup>from</sup> meeting

technology potential. The potential changes in the physical form of the local community that are expected include:

1. Alterations of the roof configuration of individual buildings to improve solar orientation;
2. Control of building heights and setbacks from property lines to reduce shading of collector area;
3. Orientation of streets and parcel dimensions to increase south-facing surface area of individual structures; and
4. Reduction in land use density and/or in energy demand per unit of floor area to reduce required collector area.

In order to achieve the scenario goal, changes would be expected only in the higher density land use types. In the multiple family dwellings case study, a uniform height for the primarily 3-to-4-story multiple family case would enable this land use type to meet the scenario goal. Since the study area included 3 high rise residential structures which could not meet ~~on-site their own~~ <sup>on-site</sup> scenario goal, and which also shaded portions of the lower rowhouse development, the study area as a whole failed to meet the scenario goal using thermal collectors with short-term storage. In order to meet the scenario goal in the MFD case, either more expensive technologies are required (photovoltaics or long-term storage) or the community could impose height restrictions to eliminate collector shading.

In the central business district variations in height is much more extreme and precludes use of the majority of roof tops~~x~~ and on-site open space. An illustration of the winter shadow pattern is included in Appendix D. Controlling the variation in building height to reduce shading of roof-top collectors would increase the solar supply. However, with height controls alone it is unlikely that the central business district could achieve the scenario goal on-site. It is also likely that changes in the density of the central business district would be necessary to achieve the scenario goal.

To increase the solar supply to the more ambitious technology potential would result in more severe impacts on the height and density of the two higher density land use types but would add few additional impacts in these or other land use types. Minor modifications to the roof configuration of individual simple family dwellings could be expected if the higher technology potential is realized.

In the industrial sector (in central city industrial sites) two of the six cases would require additional collector area to meet the scenario goal on-site.

While Table 6 does not include an evaluation of passive design, it is expected to be the most cost-effective solar "technology" in new development. (Balcomb, 1976; Lovins, 1978; State of California, 1978). However, widespread use of passive design techniques would produce more and greater impacts on the form of new development in cash land use sector. Consequently, although changes in community form are not necessary in order to meet the scenario goal, they are expected to occur as a response to the implementation of the more economical passive design.

The case study analysis, representative of a national average energy demand, indicates that the scenario goals for passive and active solar supply can be met by currently available flat plate collectors in well-insulated residences at a density of thirty dwelling units per net acre if structure height is controlled to minimize shading of collectors. Use of more efficient direct solar technologies and long-term thermal storage enables residences at that density to meet substantially more than the total DPR scenario goal for all solar technologies. Close to 100 percent of the on-site energy demand can be met at a density of sixteen dwelling units per net acre if co-generating photovoltaics become available.

Therefore, low density suburban development (typically six to eight dwelling units per net acre) is not essential in order for decentralized solar technologies to contribute a substantial portion of the community's energy demand.

#### Environmental Impacts

Table 7 is similar to Table 6 but identifies those decentralized solar technologies which would produce environmental impacts in six land use types analyzed in the case studies.

##### Water Consumption

Water consumption for direct solar technologies will vary as a function of storage volume. Short-term storage in the residential sector requires the equivalent of four to five days of water use every four or five years or an average of one day's supply per year. Commercial facilities will consume twice as much water as residential structures.

Use of long-term storage would increase water consumption, particularly if storage is maintained on an individual basis for each household. However, only short-term storage is needed to meet the scenario goal, so that the impact on a community's water supply would be insignificant relative to total water consumption.

#### Vegetation Loss

One of the primary impacts of decentralized solar technologies will be the removal of vegetation necessary to preserve an open sky-space for the on-site collector. The case study analysis indicates that the removal of trees (or pruning and shaping to reduce shading of collectors) will be an impact in the single family dwelling land use type. In order to meet the scenario goal in this residential sector, as much as 15 to 35 percent of the existing tree canopy would have to be removed.

The loss of tree canopy will affect the microclimate of the neighborhood by: 1.) eliminating important summer time cooling effects or possibly 2.) eliminating the energy saving effects of wind breaks. (Reifsnyder, 1965, in McClenon, 1977). The loss of tree canopy will also result in some reduction in habitat for birds and other animal populations.

All of the potential impacts due to loss of vegetation can be mitigated in a number of ways. The case study analysis indicates that the scenario goals can be achieved without any loss of vegetation if:

1. Collectors are located in front and back yards as well as on roofs--selectively placed to avoid the shading of existing trees;
2. Energy sharing is instituted between adjacent neighbors so that collectors can be located in a single roof-top or yard array and the thermal energy is circulated to two residences; or
3. ~~Removal of~~ <sup>Removed</sup> vegetation <sup>is replaced with</sup> with trees in alternate locations or with lower growing species.

An increase in solar reliance beyond the scenario goal can be achieved and vegetation loss can be held to 3 or 4 percent of the tree canopy if energy sharing is instituted in block-wide systems where collectors are located in any appropriate, unshaded area and thermal energy is circulated to each residence in the city block.

The trade-offs between loss of vegetation and choice of collector location or energy distribution system will be largely a local decision. The

cumulative effects of vegetation loss can not be anticipated because of the difficulty in forecasting community response to this trade-off. The long-term effects may be completely eliminated <sup>if</sup> ~~as~~ new trees are planted where the shade will not interfere with collector performance. Depending on species type, mature, urban trees can be reestablished in from 10 to 40 years. (McClenon, 1977).

In new developments, loss of vegetation may range more widely than the 15 to 35 percent reduction in vegetation found in existing neighborhoods but the adverse impacts can be minimized by design or regulation. Techniques to maximize the use of vegetation to control micro-climates include: clustering construction to permit larger "green-space" planting and planting design that maintains an effective open sky-space for collectors. (Living Systems, 1979).

#### Hazardous Wastes

Of 34 currently available chemical additives to collector working fluid, nine present no toxicological hazard to humans while 16 have been found to be toxic to varying degrees and 9 others have not been evaluated due to insufficient data (Buchan, Majestic and Bilaw, 1976). Human safety can be ensured if only the non-toxic additives are used.

Impacts on the non-human environment after disposal of working fluids have not been assessed; virtually no data have been compiled on biodegradability or the potential for concentration of these chemicals in food chains. Avoidance of impacts in the use and disposal of working fluids will require the establishment of regulations and their implementation at the community levels.

#### Visual Impacts

In an effort to enhance community identity<sup>†</sup>, increasing numbers of local jurisdictions have adopted regulations controlling the scale, bulk, form, color and texture of new structures. Such regulations demonstrate a concern for maintaining continuity in the visual appearance of the build environment. Thermal collectors and photovoltaic arrays represent a departure from the form and scale of the cornice or roofline and from the color and texture of roof materials. Passive design techniques which include south facing windows, green houses, skylights and clerestory windows, together with thermal masses, and a variety of supplemental or alternative techniques, allow for a more harmonious integration with existing

## Resource Consumption

The conversion of biomass into low-Btu gas or steam represents an irreversible allocation of resources that could be used for other purposes. Materials used for fuel include waste wood, agricultural by-products, lumber by-products, municipal solid waste and sewage sludge. Only 14 percent of the nation's forest and agricultural wastes are currently unused (see Table 8).

TABLE 8

DISPOSAL OF NATIONAL AGRICULTURAL AND FORESTRY WASTES  
(10<sup>6</sup> Dry Tons)

	<u>Crop</u>	<u>Manure</u>	<u>Forestry</u>	<u>Total</u>
Returned to soil	237	25	---	262
Fed without sale	61	---	---	61
Sold	13	.5	38	56
Fuel	9	---	19	38
Wasted	<u>2</u>	<u>6</u>	<u>59</u>	<u>67</u>
Total	322	36	119	474

SOURCE: Alrich and Witner, 1977

Of the major fuel sources for biomass conversion, municipal solid waste (MSW) is the most widely available. Of 13 primary constituents of MSW, seven can be recycled or composted to produce fertilizer. Recyclable materials include paper, glass, ferrous metal, aluminum and wood; sewage sludge, food and other household wastes can be composted. These categories comprise about 90 percent of the total MSW. Only plastics, rubber, leather and textiles cannot be recycled.

Construction of MSW conversion facilities would create a disincentive to recycle resources, to produce organic fertilizer as an alternative to petrochemical fertilizers, and to reduce waste generation.

## Water Pollution

One of the major unresolved issues is the disposal of collector working fluids. Although many are known to be toxicologically safe for humans, few have been examined for their consequences in the aquatic or marine environment. All of the MSW conversion technologies generate significant waste streams that include heavy metals, particulates and thermal pollution.

architectural style than active solar technologies.

Visual intrusion of solar collectors will be more significant in the higher density residential land use patterns where all available collector area must be used to meet the scenario goal. In low density residential patterns a choice of collector locations usually exists; collectors can be located either conspicuously or discretely, depending on the home owner's and community's values.

Meeting the scenario goal in the high density commercial land uses (the central business district case study) would require significant changes in the physical form of the development to reduce energy demand, e.g. height restrictions, passive heating and cooling, daylighting and natural ventilation, and to control shading by adjacent structures. These changes would significantly alter the visual character of the central business district of large cities. However, to meet the scenario goals for the community as a whole, solar energy does not have to be used in the central business district, so that these visual impacts need not be experienced.

Where communities are attempting to maintain the architectural character of historic districts, implementation of decentralized technologies may be particularly difficult. When historic districts include high-density land use patterns, the visual intrusion of solar collectors may be inconsistent with preservation policies. For example, in a high density neighborhood of Victorian rowhouses, meeting the 36.5 percent residential sector scenario goal would require that collectors be located on front yard set backs as well as on roofs and back yards, significantly altering the historic character of the neighborhood. In a small town "Main Street" preservation district, on the other hand, the 18 percent commercial sector goal could be met <sup>on</sup> ~~in~~ roof tops, without necessarily altering the facades. As in the case of the central business district, the scenario goal for the community as a whole could be met without the use of solar technologies in high density historic districts.

Wind machines will alter the visual character of the environment more significantly in rural and urban fringe settings than in cities. They will present a greater contrast with the horizontal character and appearances of rural development and the natural landscape than with the verticality and visual complexity of the city.

## Air Pollution

Minor contributions of particulates and simple gases can be expected from heavy reliance on wood burning stoves. Of the municipal solid waste conversion processes evaluated, more serious pollution impacts (on the order of  $10^6$  -  $10^7$  tons annually for a major city) would be generated from direct combustion or refuse-derived-fuel technologies; pyrolysis does not produce air pollution.

## Infrastructure Impacts

Siting of energy-generating devices and their accompanying storage systems have the potential to temporarily disrupt all underground utilities (gas, water, supply, sewage, telephone, cable TV) and prompt localized traffic congestion. ~~For~~ <sup>Of</sup> the direct solar supply systems evaluated, these impacts are limited for the most part to shared systems.

~~11.1#~~ Shared systems are not required to meet the scenario goals; consequently, no disruption of underground utilities is expected. ~~#~~ Once in operation, wind generators may interfere with television reception, especially ~~of~~ reception ~~of~~ <sup>from</sup> the upper UHF frequencies. Proper attention to siting and phasing new construction can reduce or minimize infrastructure impacts.

The impacts to infrastructure will primarily result from the reduced reliance on the electrical utility grid for base load energy which will increase the gap between base load and peak load demand. Since only twelve percent of residential space heat is provided by electricity (U.S. Census, 1977) and even less in the commercial sector, meeting the scenario goal will have a small impact on the electrical utilities relative to its effect on the natural gas and fuel oil facilities.

If the solar supply is increased beyond the scenario goal, the base load for cooling will be reduced. Consequently, supplying a summer peak load could become more costly. This impact may be mitigated by using thermal storage as chilled water storage during summer months.

Use of long-term thermal storage could eliminate the need for electrical back-up heating systems. More stringent conservation measures could produce the same results in areas with mild to moderately cold winter temperatures. Similarly, passive design techniques can entirely eliminate the need for electrical air conditioning in many areas if people are willing to tolerate some discomfort during the most extreme conditions.



## Noise

Decentralized applications of wind technologies will produce the most objectionable noise impacts on homes and neighborhoods. This inconvenience can be largely mitigated by siting wind generators more remotely from population centers. However, tradeoff may be necessary between mitigating noise for human communities and impacting habitat areas in more remote locations.

## Safety

Use of direct solar technologies will produce safety hazards typical of those accompanying construction and maintenance of structures. Generally, the solar supply system will be installed by someone with training in the building ~~tracks~~ <sup>Trades</sup>. However, a homeowner is likely to perform routine cleaning and maintenance. Accidents will include falls, minor burns and abrasions.

A secondary risk from direct solar systems is the glare hazard from collector panels or passive windows, this would affect automobile drivers, pedestrians, bicyclists and pilots of light aircraft. Design features such as dark, matte paints can reduce the glare hazard from collector frames.

There may be additional community impacts associated with photovoltaic arrays due to the chemical context and electrical conductivity of the cells. The stability of chemical compounds over the life of a photovoltaic system has not been demonstrated conclusively. In addition, storage batteries could pose minor risks for unsupervised children which could be readily mitigated with design features.

## Trade-Offs Among Impacts

All land use impacts, whether pre-emption of uses in existing development or changes in form in new development, are characteristically the result of trade-offs made within the community. The available choice in technologies together with the increased solar supply capability of shared systems will permit local communities to select those land use impacts which are least disruptive to community values. In the single family dwelling case study, several different combinations of technology selection and impacts can result from meeting the scenario goal. One community may wish to permit flexibility in collector location in order to eliminate loss of vegetation. Another may resort to neighborhood shared-energy systems in

order to preserve the architectural form of an historic district. Another may choose to sacrifice some tree canopy in order to minimize the social costs of organizing shared systems or regulating the visual impact of collectors placed in the yard.

In general these trade-offs permit the greatest flexibility where development patterns are less dense. Still, even in the high density central business district, a community has the opportunity to select the kinds of impacts. One kind of land use impact can, to a large extent, be traded for another. The four basic choices include:

1. Multiple use of open space in developed areas,
2. Pre-emption of an existing use or of vacant land,
3. Change in the form of development, or
4. Externalization of land use impacts by importing energy collected elsewhere in the community.

Each of the four basic choices implies a different kind of community control in order to minimize the adverse effects of potential impacts. To achieve the market penetration mix identified in the scenario, the typical community will rely to a substantial degree on on-site active systems. In this case, the controls can be generally limited to those that minimize visual intrusion, vegetation (in certain sectors), and the disposal of working fluids.

Many communities, particularly growing ones that are adding substantially to their existing form, will have the opportunity to emphasize energy collection through passive design techniques. In this case, the more expensive active systems are not necessary. A new home could meet the scenario goal of 36.5 percent of its total end use demand with passive design and active solar hot water heating (Balcomb, 1977). It will be necessary, however, to increase the number of controls on new development if passive design is to be applied on a wide scale. The physical limits and consequential impacts of this potential resource have not been fully explored.

Ultimately, the kinds of land use or environmental impacts that result from achieving the DPR scenario goal for decentralized solar energy will be the result of decisions made by individuals and local governments operating within the context of an existing pattern of development and value system. No particular land use impact discovered in this analysis is necessitated in order to meet the scenario's goal.



KEY

## Technology Type:

1. Direct Solar Thermal Collectors with existing output and short-term storage.
2. Direct Solar Thermal Collectors with improved output and short-term storage.
3. Cogenerating Photovoltaics with short-term storage.
4. Direct Solar Thermal Collectors with existing output and long-term storage.
5. Direct Solar Thermal Collectors with improved output and long-term storage.
6. Cogenerating photovoltaics with long-term storage.
- W. 10 KW wind machines.
- B. Biomass conversion (wood burning in residential sectors, NSW in commercial sectors, and agricultural and forestry residences in industrial sector).

Tech Goal: The maximum amount of the total energy demand that can be supplied by a particular direct solar technology assuming unlimited collector area.

DPR Goal: The scenario goal established by the Policy Planning Review Commission.

NOTES

- a. In the industrial sector, the technologies are matched to process heat requirements (see text) and the % of cases indicates the relative amount of cases analyzed where potential impacts were encountered with the single technology applied.
- b. Alteration of existing setback controls could reduce impacts on vegetation loss (see Environmental Impacts).

DECENTRALIZED SOLAR TECHNOLOGIES THAT WOULD PRODUCE ENVIRONMENTAL IMPACTS IN SIX LAND USE TYPES IN ORDER TO ACHIEVE THE MAXIMUM AMOUNT OF TOTAL ENERGY DEMAND OR TO ACHIEVE THE DPR SCENARIO GOAL.

LAND USE TYPE												
	SFD			RFD			Strip			CHD		
	Tech Goal	DPR Goal		Tech Goal	DPR Goal		Tech Goal	DPR Goal		Tech Goal	DPR Goal	
Water Consumption	1234	1234		1234	1234		1234	1234		1234	1234	
	56	56	56	56	56		56	56	56	56	56	100
Vegetation Removal	123											0
Hazardous Wastes	1234	1234		1234	1234		1234	1234		1234	1234	
	56	56	56	56	56		56	56	56	56	56	100
Visual Intrusion	1234	1234		1234	1234		1234	1234		1234	1234	
	56WB	56WB	56WB	56WB	56WB		56WB	56WB	56WB	56WB	56WB	100
Resource Consumption	B	B	B	B	B		B	B	B	B	B	50
Infrastructure Disruption	1234	1234		1234	1234		1234	1234		1234	1234	
	56	56	56	56	56		56	56	56	56	56	100
Water Pollution	1234	1234		1234	1234		1234	1234		1234	1234	
	56 B	56 B	56 B	56 B	56 B		56 B	56 B	56 B	56 B	56 B	100
Air Pollution	B	B	B	B	B		B	B	B	B	B	50
Safety	1234	1234		1234	1234		1234	1234		1234	1234	
	56W	56W	56W	56W	56W		56WB	56WB	56WB	56WB	56WB	100
Noise	W	W	W	W	W		WB	WB	WB	WB	WB	0

INDUSTRY<sup>a</sup>  
(% of cases)

KEYTechnology Type:

1. Direct Solar Thermal Collectors with existing output and short-term storage.
2. Direct Solar Thermal Collectors with improved output and short-term storage.
3. Cogenerating Photovoltaics with short-term storage.
4. Direct Solar Thermal Collectors with existing output and long-term storage.
5. Direct Solar Thermal Collectors with improved output and long-term storage.
6. Cogenerating photovoltaics with long-term storage.
- W. 10 KW wind machines.
- B. Biomass conversion (wood burning in residential sectors, MSW in commercial sectors, and agricultural and forestry residences in industrial sector).

Tech Goal: The maximum amount of the total energy demand that can be supplied by a particular direct solar technology assuming unlimited collector area.

DPR Goal: The scenario goal established by the Policy Planning Review commission.

NOTES

- a. In the industrial sector, the technologies are matched to process heat requirements (see text) and the % of cases indicates the relative amount of cases analyzed where potential impacts were encountered with the single technology applied.

### Application of Findings

This report has evaluated the potential community level impacts that would result from wide spread implementation of on-site solar energy technologies. To do so, it was necessary to establish the connection between community land use patterns and energy use.

The findings indicate that most potential impacts to the community will be those affecting land use. Consequently, many of the findings are of direct interest to local land use planners. Whether a community is a growing metropolis with the opportunity to shape its future energy use characteristics or whether a community is an established, built-out area trying to reduce its reliance on centralized energy sources, the findings in the report illustrates how solar technologies are constrained by development patterns. In any locality, it will be important for land use planners to understand the connection between energy use and land use in order to develop community goals and policies to make cities more energy efficient. Using the framework established in this study, a local community could easily inventory its potential energy savings from a variety of community interventions. The first step would be to categorize its existing development into "energy sensitive land use types."

The significance of the findings in this report to state or regional governments lies in the demonstration that particular regulatory interventions are going to produce varying results in different land use types. The ultimate goal of reducing energy consumption will not be achieved with a single legislative act.

This report has not evaluated the potential contribution that passive design techniques can make to reducing reliance on centralized energy sources. The potential of passive design has been studied in isolation but not systematically applied to the broader development context. While passive<sup>design</sup> was largely ignored in the scenario, accounting for only about one-sixth of the residential sector and one ninth of the commercial sector supply, the potential economic advantages of passive energy design over active systems suggests that it should be given significantly more consideration. An increased effort should be made to demonstrate the practical application of passive design techniques and to assess the community consequences of their implementation.

## REFERENCES

Alich, John A., Jr., and Witner, Jeffrey G., "Agricultural and Forestry Wastes as an Energy Resource," in Sharing the Sun: Solar Technology in the Seventies, Vol. 7, Agriculture, Biomass, New Developments, 1977.

Anderson, Bruce, The Solar Home Book: Heating, Cooling, and Designing with the Sun, Harrisville, N.H.: Cheshire Books, 1976.

Arthur D. Little, Inc. Energy Conservation in New Building Design: An Impact Assessment of ASHRAE Standard 90-75. Conservation and Environment Buildings Program Conservation Paper 45B, 1975.

Arthur D. Little, Inc. Solar Heating and Cooling of Buildings (SHACOB) Commercialization Report. Part B-Analysis of Market Development. Volume II-Technical Report (IHCP/M70066-01/2) U.S. Dept. of Energy Task Force on Solar Energy Commercialization/September, 1977.

Balcomb, J. Douglas and Hedstrom, J.C., "Simulation Analysis of Passive Solar Heated Buildings-Preliminary Results," Los Alamos Scientific Laboratory, LA-UR-76-89.

Bartholemew, Harland, Land Use in American Cities. Cambridge: Harvard University Press, 1955.

Battelle Columbus Labs/for D.O.E., Honeywell, Inc. Survey of the Applications of Solar Thermal Energy Systems to Industrial Process Heat, 1977. (TLD-273448/1)

Bernstein, Harvey M., and McCarthy, Patrick M., A Study of the Physical Characteristics, Energy Consumption, and Related Institutional Factors in the Commercial Sector. Columbia, Maryland: Hittman Associates (HIT-630).

Boykin, Industrial Potential of the Central City, Washington, D.C.: Urban Land Institute, 1973.

Buchan, R.M., Majestic, J.R., and Billau, R. Toxicological Evaluation of Liquids Proposed for Use in Direct Contact Liquid-Liquid Heat Exchangers for Solar Heated and Cooled Buildings. COO/2867-1 Energy Research and Development Administration, September, 1976.

California, State Office of Appropriate Technology. Design for Site One, Passive Office Building Design, 1978.

California, State Solid Waste Management Board, Refuse to Energy Conversion Project, December, 1977.

General Electric for ERDA Study for Defining the Number of Residential and Non-Residential Projects (COO/2683-70/2) SHACOB Phase O, 1974.

General Electric, Solar Heating and Cooling of Buildings Phase O: Feasibility and Planning Study. Final Report, 1974. (NSF-RA-N-74-021D).

George Washington University, Office of Energy Programs. Social Assessment of On-Site Solar Energy Techniques, 1978.



## REFERENCES (Cont.)

- Harwood, Corbin Crews. Using Land to Save Energy, Environmental Law Institute State and Local Energy Conservation Project, Cambridge, Massachusetts: Ballinger Publishing Company, 1977.
- Hittman Associates, Inc. Residential Energy Consumption Multi-Family Housing Data Acquisition. (Pub. HUD-PDR 29-5) October, 1972. Dept. of Housing and Urban Development.
- Hittman Associates, Inc. Residential Energy Consumption (A Summary Report) (HUD-HAI-8). July, 1974.
- Intertechnology Corporation, Proposed Systems Level Plan for Solar Heating and Cooling Commercial Buildings. National Solar Demonstration Program. Volume 1-3. Warrenton, Virginia: Intertechnology Corporation, May 1976. (COO/2688-76/6 (Vol. 3)).
- Intertechnology Corporation for D.O.E., Analysis of the Economic Potential of Solar Thermal Energy to Provide Industrial Process Heat, 1977. (COO/2829-2)
- Jackson, Jerry R., and Johnson, William S., Commercial Energy Use: A Disaggregation by Fuels, Building Type, and End Use, 1978. (ORNL/CON-14)
- Lawrence Berkeley Laboratory, "Characterization of Solid Waste Conversion and Cogeneration Systems", LBL-7883, August, 1978(2).
- Lovins, Amory, Soft Energy Paths: Towards A Durable Peace. San Francisco: Friends of the Earth International, 1977.
- Living Systems. Energy Conservation Building Code Workbook. Housing and Urban Development Innovative Project Grant. The City of Davis, California, July, 1976.
- Living Systems for ASPO, Site Planning for Solar Access, 1979. (National Solar Heating and Cooling Information Center)
- Manvel, Allen D., "Land Use in 106 Large Cities," in Three Land Research Studies. The National Commission on Urban Problems Research Report No. 12. Washington, D. C., 1968.
- McClenon, Charles, ed. Landscape Planning for Energy Conservation. (Report for National Bureau of Standards and Housing and Urban Development.) American Society of Landscape Architects Foundation, McLean, Va., 1977.
- Niedercome & Hearle. Recent Land Use Trends in 48 Large American Cities. Rand Corp. RM-3664-FF, June 1963.
- Real Estate Research Corp., The Costs of Sprawl. Detailed Cost Analysis and Executive Summary, 1974. (Prepared for CEQ, HUD, EPA). Chicago: Real Estate Research Corp.
- Rosenfeld, Arthur H. et al. "Conservation Options in Residential Energy Use: Studies Using the Computer Program Twozone:", Lawrence Berkeley Laboratory, University of California, 1977.

Mr. HUGHES. Our next witness is Mrs. Susanna Jacob, chairman of the Environmental Action Committee of West Marin.

### STATEMENT OF SUSANNA JACOB

Mrs. JACOB. Thank you, Mr. Chairman and gentlemen. Our committee is relatively small, locally based, what we like to call a rural land-use planning organization with a strong environmental commitment. However, for today's purposes I would like to list the following organizations as people who are local that we are representing.

We have the Inverness Association, the Tomales Bay Association, the Inverness Park Association, the Tomales Bay Sportsmen, the Inverness Ridge Association, the Point Reyes Station Business Association, Pelican Alliance, and the Stinson Beach Village Association. In addition to that, we also want to mention Audubon Canyon Ranch, which owns several miles of our coastline and many hundreds of acres.

Finally, we are representing a body which has the oversight of 1,400 acres of our coastline that I think you passed by this morning, all designated as natural reserve and marked by the County of Marin. And requested by the County of Marin has been a study by the U.S. Army Corps of Engineers of this particular area, baseline study of a natural system in a natural state, for which about a million dollars of Federal funds have already been allocated.

So with that, let me tell you some of the concerns of the local people out here. We are particularly concerned about earthquakes. We have the unhappy distinction of being right on top of the San Andreas Fault. We have found it to be a rather fractious neighbor. Although modern technology may be marvelous, we have not found anybody that will control it for us.

Second, we are concerned about major disaster situations such as oil spills, with which we are very familiar. There was a major oil spill in Bolina Lagoon in 1971. Many of the local folks were involved in the cleanup for it. We know how ugly and bad that can be for our local beaches and wildlife.

Third, we are concerned with what we read may be the least perceptible but equally dangerous long-range effects of oil leakage upon our coast. And I know that probably yesterday you received much testimony with respect to the fact that modern technology was going to take care of all of us. However, most of us out here read the papers and we are fully familiar with Murphy's law, that if anything can go wrong, eventually it will. And we are rather concerned about that.

So with those concerns in mind, we thought that we would outline for you this morning some of the things that we feel up here that might be endangered should we remain part of Lease Sale 53.

In particular, I wanted to mention natural resources, which I will be mentioning from a slightly different viewpoint from your other statements. Both by luck and good stewardship, Tomales Bay enjoys the reputation of being one of the most pristine bodies of salt water in the United States. Scientists are able to study it as a prime example of marine and estuarine life and life support systems. Students and the general public have the unique opportunity

of sharing in these studies. Our farmers have done their share by installing costly dairy pollution control methods so that whatever comes out of this lovely bay and the surrounding ocean waters is both fit and choice for human consumption.

For example, we have a healthy local salmon and steelhead run which is enjoyed by commercial and sportfishermen alike. Commercial drag boats supply snapper, cod, and sole to our markets, and crab pots are set out in season. Local residents and visitors use our area extensively for catches of clams, mussels, and abalone. Additionally, we have a burgeoning mariculture industry here, which includes oyster farming and salt water salmon rearing. Each year, the herring come into Tomales Bay to lay their eggs in the eel grass, replenishing the stock and providing a livelihood for our herring fishermen.

Seals and sea lions use our beaches and estuaries to rear their young and the California gray whale passes by our shores twice yearly, an event which attracts thousands of whale watchers. The notorious great white shark has her nursery in Drakes Estero, where, to our knowledge, she has never eaten anyone, though skin divers must be wary off the mouth of Tomales Bay.

As for birds, we lie under a great flyway of migratory birds. Thousands of people come here to bird watch, and the Christmas bird count is deemed a great occasion. Hunters bag game birds off the bay, and the Farallon Islands off our shore are the largest breeding grounds for sea birds between Alaska and Mexico.

It goes without saying that all of the above-mentioned natural resources are dependent upon the continuance of a healthy environment in our streams, marshes, estuaries, bays, and coastal waters.

The second point is what we call our recreational situation, which you passed all too briefly through this morning on your way up here. A large portion of our land is held in public ownership for parklands and nature preserves through Federal and State purchases, as well as vested public rights held in trust by the State Lands Commission. Many of us worked hard and long in local citizen organizations to insure the purchase of Point Reyes National Seashore and Golden Gate National Recreation Area, upon which millions of dollars were spent, and when that was done, we went to work again to set aside parts of this beautiful place in permanent wilderness reserve so that future generations may enjoy it as we have.

Point Reyes has close to two million visitors a year. If you include the Point Reyes National Seashore, Golden Gate National Recreation Area, and the local parklands, we have close to 7 million visitors a year. And I thought it might be interesting to you to see what the visitor dollar might be out here. So I called our local chamber of commerce. I had rather a brief time to prepare my testimony. So all I could get was a national average, which is about \$50 per person per 24-hour visit.

I would say that that would be rather high for our area, because we service a lot of local people who come out here for just a day, and a lot of things we have out here we are very proud they are free—they have already been paid for by tax dollars. Even if you were to take a tenth of \$50 per person per visit, we are talking

about a \$35 million per year visitor industry. That is only the people counted by the little traffic counters in the park, and not people that might just come out to look around.

Additionally, I think—I don't want to go into all the lovely things that you can do out here, because I am sure you can imagine with all the clamming and fishing and sitting on the beaches. I am just sorry you cannot be here long enough to enjoy it.

Mr. HUGHES. We might be tempted to stay.

Mrs. JACOB. Why not?

Anyway, one thing I do want to mention in closing is I think we would be remiss if we did not say something about children. Those of you who are fortunate enough to live out here have the benefit of having our children grow up out here in a beautiful environment. We do not happen to have a movie theater in town, nor a drive-in, or a penny arcade. But we do have what we think is much nicer, but even more important than what we locals happen to enjoy is that we do provide for the bay area's counties, which is the San Francisco Bay region, we provide an opportunity for inner-city children, who have never seen a clam or a crab or even a cow, to come out here and enjoy that kind of an experience. And we do encourage that. We think this area is for them as well.

So with all the foregoing in mind, we want to conclude our testimony with the following thought: People that are more expert than we are will be telling you about roughly how little oil there is off our particular portion of the coast. It seems to us that, morally and economically, it just does not make good sense to put at risk our parks, our renewable resources and our environment for such a small thing. We think that we have got something going that will last for generations. And we want you to be very careful with our coast. And we appreciate the opportunity of addressing you.

Thank you very much.

[The information follows:]

ENVIRONMENTAL ACTION COMMITTEE OF WEST MARIN,  
*Point Reyes Station, Calif., August 24, 1979.*

Re testimony for hearing on lease sale #53, August 30, 1979.

To: House Select Committee on the Outer Continental Shelf.

Attention: John Murphy, Chairman.

By way of introduction, we are a rural land use planning organization with strong environmental commitments. We draw our membership from the western part of Marin County which is essentially rural and includes as residents commercial fishermen, farmers, and others who live from the land, as well as business and professional people who live on it. Sharing the area with us locals are the hundreds of thousands of visitors who come here to enjoy our public parklands.

For the purpose of this testimony, we are also empowered to represent the following local organizations: The Inverness Association, The Tomales Bay Association, The Inverness Park Association, The Tomales Bay Sportsmen, The Inverness Ridge Association, and The Point Reyes Station Business Association.

These are some of the things we are afraid of with respect to Lease Sale #53 as it relates to our coast. (1) Earthquakes. We have the unhappy distinction of being right on top of the infamous San Andreas Fault and cannot believe that present technology, sophisticated though it may be, can do much to calm this fractious neighbor of ours. (2) Disasters. We have first hand information on what an oil spill can do to our beaches and wildlife, having worked on clean up for the Bolinas Oil Spill in 1971. We fear the shadow of the Amoco Cadiz or the current Pemex blowout that even the legendary Red Adair is having trouble with. (3) Long Range Impacts. We are also concerned with the less perceptible but equally dangerous effects of slow leakage, subsidence, and the like.

We are well aware that you must be receiving voluminous testimony to the effect that the magic of modern technology is going to be able to handle all this. Nonetheless, one need only read the daily papers to see strong evidence in support of Murphy's Law, that if anything can go wrong, eventually it will.

As people who live, work, and raise our children here, we think we have a good working knowledge of what kinds of things would be endangered should we remain part of Lease Sale #53 and we are grateful for this unprecedented opportunity of sharing our concerns with you.

#### NATURAL RESOURCES

Both by luck and good stewardship, Tomales Bay enjoys the reputation of being one of the most pristine bodies of salt water in the United States. Scientists are able to study it as a prime example of marine and estuarine life and life support systems. Students and the general public have the unique opportunity of sharing in these studies. Our farmers have done their share by installing costly dairy pollution control methods so that whatever comes out of this lovely bay and the surrounding ocean waters is both fit and choice for human consumption.

For example, we have a healthy local salmon and steelhead run which is enjoyed by commercial and sportfishermen alike. Commercial drag boats supply snapper, cod, and sole to our markets and crab pots are set out in season. Local residents and visitors use our area extensively for catches of clams, mussels, and abalone. Additionally, we have a burgeoning mariculture industry here, which includes oyster farming and salt water salmon rearing. Each year, the herring come into Tomales Bay to lay their eggs in the eel grass, replenishing the stock and providing a livelihood for our herring fishermen.

Seals and sea lions use our beaches and estuaries to rear their young and the California Gray Whale passes by our shores twice yearly, an event which attracts thousands of whale watchers. The notorious Great White Shark has her nursery in Drakes Estero, where, to our knowledge, she has never eaten anyone, though skin divers must be wary off the mouth of Tomales Bay.

As for birds, we lie under a great flyway of migratory birds. Thousands of people come here to bird watch, and the Christmas Bird Count is deemed a great occasion. Hunters bag game birds off the bay and the Farallon Islands off our shores are the largest breeding grounds for sea birds between Alaska and Mexico.

It goes without saying that all of the above mentioned natural resources are dependent upon the continuance of a healthy environment in our streams, marshes, estuaries, bays, and coastal waters.

#### RECREATION

A large portion of our land is held in public ownership for parklands and nature preserves through Federal and State purchases, as well as vested public rights held in trust by the State Lands Commission. Many of us worked hard and long in local citizen organizations to ensure the purchase of Pt. Reyes National Seashore and Golden Gate National Recreation Area, upon which millions of dollars were spent, and when that was done, we went to work again to set aside parts of this beautiful place in permanent wilderness reserve so that future generations may enjoy it as we have.

Pt. Reyes has close to two million visitors a year. Besides offering enjoyment to visitors from far away, it provides the major recreation opportunity for our urban neighbors in the nine Bay Area Counties which make up the San Francisco region. You can get here and back home on a tank of gas, or, as more and more people are doing nowadays, take a bus. Once here, the options are so varied that it would be impossible to list them all. One can hike, fish, bird watch, swim, canoe, or just lie on a clean quiet beach and watch the waves rolling in. Recreation means to re-create oneself, and we think this is a good place to do just that.

We would be remiss if we didn't say something about children. Those of us who live out here are lucky in that our children have such a beautiful and interesting area to grow up in. Our town doesn't have a movie theatre, a penny arcade, or a pool hall, but we have something that we think is perhaps a little better. Even more important, inner city children who have never seen a raccoon, a crab, or even a cow, can and do come out here in great numbers. We think this place is for them too.

With all of the foregoing kept firmly in mind, let us conclude our testimony with the following thought: People more expert than we will be telling you how little oil there is off our part of the coast. Morally and economically, it just doesn't make good sense to put at risk our parks, our renewable resources, and our environment for such a pittance.

We want to thank you for this opportunity of addressing you and want to wish you wisdom and fortitude in your deliberations.

Sincerely,

SUSANNA JACOB, *Chairman.*

Mr. HUGHES. Thank you.

Our next witness is Mr. Richard Charter, with Friends of the Coast. Likewise, your statement is included in the record. You may proceed to summarize it.

### STATEMENT OF RICHARD CHARTER

Mr. CHARTER. Thank you.  
[The information follows:]

#### TESTIMONY PRESENTED BY RICHARD A. CHARTER, FRIENDS OF THE COAST

I would like to thank Chairman Murphy and the Committee for this opportunity to help clarify, in a cooperative spirit, some of the questions that have arisen with respect to public acceptance of the offshore drilling proposals inherent in Lease Sale #53.

I speak to you today on behalf of a broad base of citizens who are actively concerned about the impacts of these proposals on our pristine coastal environment, our commercial and sports fishery, and our regional economy as it now exists. We have in Northern California a number of different constituencies which have expressed intelligent and respectful concerns related to this proposal. I speak to you today on behalf of one of these constituencies, and these sentiments are echoed in kind by the many groups and individuals who would have welcomed the opportunity to provide direct input to this Committee if the format of these hearings had so permitted.

As I appear today on behalf of Friends of the Coast, I will tell you a bit about this particular organization. Created in response to the announcement of offshore leasing plans, Friends of the Coast represents a strong and stable constituency of fishermen, coastal property owners and business persons, coastal recreationists from inland areas, and others who share a sense of awe and inspiration at the rugged beauty of the Northern California coast. An interesting aspect of our organization is that it is not comprised primarily of people with a history of involvement in environmental issues, but rather ordinary individuals who feel that this place is very special, and in no way the right target area for OCS activities. If there is one common chord, one common thought, expressed by the people I represent here today, it is the phrase I hear most often when someone asks me about the leasing proposals: "I was born here and I've lived here all my life." or "I've been coming here since I was a kid, and I just can't believe that they'd consider offshore drilling here." And that is the starting point, that is the place from which I speak to you today, as a native Californian, whose first reaction upon hearing of the lease sale was one of disbelief and shock that anyone could consider OCS activities an appropriate use for this particular stretch of coast. It is all too clear to us now that such use is indeed deemed appropriate by the Federal agencies involved, but I think that it is critical that one keep in mind that to most of us, not much more than a year ago, a proposal such as the one now before us was unthinkable.

What I would like to do at this time is to provide the Committee with some insight into the high level of concern which has been evidenced throughout the leasing process to date, and to explain why this concern is so strong with respect to this particular area. At the same time I would like to offer some suggestions as to how the process can be improved and made more responsible and hopefully provide improved opportunities to assure that all concerns are addressed adequately prior to the leasing process proceeding to completion.

As you look at solid coastal county opposition, loud and visible citizen opposition with identified concerns, strong state leadership, and a concerned California Congressional delegation, the obvious question is "Why should there be all of this controversy about this particular lease sale?"

The beginning of the answer lies in the fact that at the point when most citizens and elected representatives first learned of the Department of Interior's accelerated leasing program it was immediately clear that it was a rigid process, designed to expedite the sale by keeping the leasing schedule "on track", but formulated primarily without consultation or input from the affected areas. This abrupt introduction to an ongoing process which was obviously going to have very significant

impacts on the local and regional status quo was somewhat tempered by assurances from BLM that the process of tract selection was an open one and that responses from affected jurisdictions would be incorporated in the deliberation process. However, the National OCS leasing schedule permitted us to enter our objections only by utilizing the restrictive formats of nomination, commentary, and EIS.

In the case of Sonoma County, where I live, a set of overlays, comprising sets of negative nominations based on various factors such as intensity of recreational use, sensitivity of coastal habitats, and fisheries sensitivity was submitted within an extremely short comment period by our Board of Supervisors and comprised comprehensive negative nominations, substantiated with specific backup data. As a result, or perhaps I should say, for no apparent reason, the final tracts selected by BLM for inclusion were right in the middle of the fishing grounds. As you have heard in other testimony, similar experiences have been the rule in the case of other coastal counties, and fragile, productive areas which contain important renewable resources have been included in the lease sale. The tracts now included in Lease Sale #53 read like a who's who of the most treasured and sensitive parts of the coastline of Northern California, and as such, an outrage born of pride and protectiveness has arisen in response to the leasing proposals at all levels of representative government and throughout the general public.

This concern has been compounded, as I have pointed out, by the lack of responsiveness shown on the part of BLM to invited comments and an unprecedented level of public interest and participation in the process. In view of the relationship between the coastal communities and the marine environment, a more effective methodology for addressing local and regional concerns must be introduced. Too much is at stake to proceed with the present unresponsive and seemingly unalterable process, which seems to have started with a foregone conclusion and then moves inexorably to validate that conclusion no matter how controversial or inappropriate the result may be.

There are a number of clear and readily identified conflicts behind this citizen concern. A matrix for considering the sensitivity of the coastal areas impacted by Lease Sale #53 can be divided into three categories:

- (1) Intensive public recreational use and high aesthetic values.
- (2) Sensitive types of coastal and intertidal habitats.
- (3) Impacts on significant regional economies based on tourism and an active sports and commercial fishery.

Let's look at the first point and explore the aesthetic and recreational aspect of this situation. No one would argue the aesthetic importance of this coastal area—when you pick up a calendar, and one of the months is illustrated by a seacoast photograph, you can be reasonably sure that the scene is somewhere along this coast. This is the coast that people come from all over the world to look at and to photograph, and as such, it is a national resource in and of itself and a public treasure. Its significance as a recreational resource is reflected in an almost continuous band of state and regional parks along the coast, with public access to the beaches provided at frequent intervals. The primary mainstay of the many regional economies is recreation, and in Mendocino County it ranks second only to the lumber industry. Studies have shown that in Mendocino County some half a million people visit the coast each year with a cumulative economic impact in excess of \$100 million. The national significance of this coastal recreational resource is reflected here in Point Reyes National Seashore itself, and not so many years ago, in a time when different values prevailed, Lady Bird Johnson upon dedicating the National Seashore advised us to be thankful for and treasure this special legacy. The values that were protected by national recognition of this sensitive area are still here, and have not been diminished by a hasty reordering of national priorities. It is quite clear that the present leasing proposals are in conflict with strong regional and statewide commitments to certain concepts of coastal land management and that as hundreds of millions of dollars have been invested in coastal parklands, a sense of reverence and protectiveness for this special coastline has prevailed.

There are also a number of simple geographic and environmental considerations which make this area particularly sensitive to impacts associated with OCS proposals. The OCS Land Act require Interior to consider "the relative environmental sensitivity and marine productivity of different areas of the OCS, (Section 18(a)(2)(B)), but the proposed leasing schedule does not seem to be based on these factors at all; in fact the schedule provides no ranking of the 22 OCS areas together for comparison of these factors. There are some qualitative comparisons of areas within each of the four overall OCS regions, but nowhere is there any indication these comparisons were used to determine the location and timing of lease sales. Instead the proposed California sales are defined as such broad areas, i.e., the entire California OCS, so

that relative environmental sensitivity of offshore basins cannot be incorporated in the decision. Although Interior interprets Section 11(h) of the OCS Lands Act which excludes leasing within 15 miles of Point Reyes National Seashore specifically to be intended to exclude no other OCS area from leasing (Tab B, Foreword, pp. 2-3) this not at all means that the Secretary of Interior cannot or should not exclude other OCS areas from leasing, and the program should explicitly include analysis of those specific basin-level OCS areas where low petroleum resource potential and high environmental risks merit exclusion from the schedule. If Interior conducted the required analysis of all of the factors, such decisions could be made on a tract specific basis. As it is the analysis is so gross that no comparisons can be made.

What constitutes a particularly sensitive area?

Look at any map of the Northern California coastline and you will see a convoluted and rocky coastline dotted with bays, estuaries, coves, and reefs. It is a well known fact that this type of coastal configuration, and its attendant abundance and variety of marine life is the most sensitive kind of environment in the event of an oil spill. Because of the proximity of many lease sale tracts to spawning and breeding grounds, rich tide pool areas, and untouched estero such as the Estero American, and the Estero de San Antonio, it is clear that any OCS development should be directed away from this type of sensitive area, particularly in a non-industrial coastal region where there has not been a history of previous petrochemical stress in the marine environment. It is important to note that numerous areas along this coast have been already designated as Areas of Special Biological Significance. Endangered species such as the osprey and brown pelican are involved, and the Farallon Islands represents the largest seabird rookery in the Continental U.S.—almost directly adjacent to the Bodega Basin tracts included in Lease Sale #53. In addition, Marine Reserves exist at Gerstle Cove, Bodega Marine Lab, Tomales Bay, Point Reyes Headlands, Estero de Limantour, and Duxbury Reef as well as the Farallon Islands. The commercial fisheries and coastal birds are rated as most environmentally sensitive, and significant use conflict is projected with seabird life.

It is clear that the existing environmental studies program does not evaluate fully and adequately existing resources. Several studies which are already funded and underway which will provide needed baseline data will not be completed in time to be evaluated for the EIS.

It is clear that areas with the highest aesthetic and recreational or biological value must be identified by a coastal resource inventory and should receive special consideration. The full costs of leasing in a given area must be disclosed and the full range of alternatives considered, including a delayed sale, tract deletion, and no sale options.

A lease sale in this region should not even be considered until adequate baseline studies are complete. The existing EIS timeframe is undoubtedly too short a period to determine what changes will actually occur in a specific marine ecology. This could lead the EIS to concentrate more on short-term environmental impacts of drilling and spills while neglecting the long-term and more subtle sub-lethal effects.

In light of a widespread controversy based on these and other factors, how then can we proceed?

How can this Committee successfully mediate a truce between local concern which far surpasses anything our areas has ever experienced and a fixed and unresponsive program which promises but does not respond to public input in the decisionmaking process?

Toward this end I would like to submit four recommendations:

(1) An expanded timeframe for Lease Sale #53 because of its nature as a Frontier Area of particular sensitivity and because studies now funded and underway are essential to provide adequate baseline information for a comprehensive EIS.

(2) A comparison of relative environmental sensitivity on a basin by basin basis, with deletion from the schedule of basins that have low petroleum reserve potential and high environmental sensitivities.

(3) The EIS should place particular emphasis on identifying impacts which cannot be fully mitigated, such as the potential long term effects of low level pollution on fishery resources or the visual degradation.

(4) Northern and Central California OCS should be regarded as a national security reserve—the lease sale should be delayed until institutional arrangements are created whereby exploration to determine potential reserves can be accomplished without a commitment to actual development. The area should be developed only as a strategic national reserve, with production to proceed only in the event of extreme need. Options such as these hold the potential of permitting a middle path to be achieved with regard to these areas.



In conclusion, I would like to point out that it is one thing to establish a fixed set of priorities in order to meet certain goals, but if the priorities are so rigid that they fail to recognize a place that is so special, so irreplaceable, and so untouched that they proceed anyway in the face of statewide public controversy and in haste make a mistake, then we are, all of us, the poorer. We have right at this moment the situation in the Gulf of Mexico to remind us of the potential magnitude of our mistakes.

We have many other energy options open to us, and in California these options are gaining widespread acceptance. Sonoma County boasts the largest geothermal power complex in the U.S., providing roughly enough energy to power San Francisco. Many California counties have adopted or are considering end use energy conservation codes for buildings—to encourage efficient use of energy and maximum solar utilization.

We have an obligation to continue to preserve and respect the special natural heritage of our region, and to remember that we are not yet so desperate that we must burn our cathedrals for firewood.

Thank you.

Mr. CHARTER. I would like to thank the committee for this opportunity to help clarify, in a cooperative spirit, some of the questions that have arisen with respect to public acceptance of offshore drilling proposals inherent in lease sale No. 53.

I speak to you today on behalf of a broad base of citizens who are actively concerned about the impacts of these proposals on our pristine coastal environment, our commercial and sports fishery, and our regional economy as it now exists. We have in northern California a number of different constituencies which have expressed intelligent and respectful concerns related to this proposal. I speak to you today on behalf of one of these constituencies, and these sentiments are echoed in kind by the many groups and individuals who would have welcomed the opportunity to provide direct input to this committee if the format of these hearings had so permitted.

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If there is one common chord, one common thought, expressed by the people I represent here today, it is the phrase I hear most often when someone asks me about the leasing proposals: "I was born here and I've lived here all my life," or "I've been coming here since I was a kid, and I just can't believe that they'd consider offshore drilling here." And that is the starting point, that is the place from which I speak to you today, as a native Californian, whose first reaction upon hearing of the lease sale was one of disbelief and shock that anyone could consider OCS activities an appropriate use for this particular stretch of coast.

It is all too clear to us now that such use is indeed deemed appropriate by the Federal agencies involved, but I think that it is critical that one keep in mind that to most of us, not much more

than a year ago, a proposal such as the one now before us was unthinkable.

What I would like to do at this time is to provide the committee with some insight into the high level of concern which has been evidenced throughout the leasing process to date, and to explain why this concern is so strong with respect to this particular area. At the same time I would like to offer some suggestions as to how the process can be improved and made more responsive and hopefully provide improved opportunities to assure that all concerns are addressed adequately prior to the leasing process proceeding to completion.

As you look at solid coastal county opposition, loud and visible citizen opposition with identified concerns, strong State leadership and a concerned California congressional delegation, the obvious question is, Why should there be all of this controversy about this particular lease sale?

The beginning of the answer lies in the fact that at the point when most citizens and elected representatives first learned of the Department of the Interior's accelerated leasing program it was immediately clear that it was a rigid process, designed to expedite the sale by keeping the leasing schedule on track, but formulated primarily without consultation or input from the affected areas.

This abrupt introduction to an ongoing process which was obviously going to have very significant impacts on the local and regional status quo was somewhat tempered by assurances from BLM that the process of tract selection was an open one and that responses from affected jurisdictions would be incorporated in the deliberation process. However, the national OCS leasing schedule permitted us to enter our objections only by utilizing the restrictive formats of nomination, commentary, and EIS.

In the case of Sonoma County, where I live, a set of overlays, comprising sets of negative nominations based on various factors such as intensity of recreational use, sensitivity of coastal habitats, and fisheries sensitivity was submitted within an extremely short comment period by our board of supervisors—ratified, by the way, by the board of supervisors completely—and comprised comprehensive negative nominations, substantiated with specific backup data. As a result, or perhaps I should say, for no apparent reason, the final tracts selected by BLM for inclusion were right in the middle of the fishing grounds.

As you have heard in other testimony, similar experiences have been the rule in the case of other coastal counties, and fragile, productive areas which contain important renewable resources have been included in the lease sale. The tracts now included in lease sale No. 53 read like a who's who of the most treasured and sensitive parts of the coastline of northern California, and as such, an outrage born of pride and protectiveness has arisen in response to the leasing proposals at all levels of representative government and throughout the general public.

This concern has been compounded, as I have pointed out, by the lack of responsiveness shown on the part of BLM to invited comments and an unprecedented level of public interest and participation in the process. In view of the relationship between the coastal communities and the marine environment, a more effective meth-

odology for addressing local and regional concerns must be introduced. Too much is at stake to proceed with the present unresponsive and seemingly unalterable process, which seems to have started with a foregone conclusion and then moves inexorably to validate that conclusion no matter how controversial or inappropriate the result may be.

There are a number of clear and readily identified conflicts behind this citizen concern. A matrix for considering the sensitivity of the coastal areas impacted by lease sale No. 53 can be divided into three categories:

First, intensive public recreational use and high esthetic values.

Second, sensitive types of coastal and intertidal habitats.

Third, impacts on significant regional economies based on tourism and an active sports and commercial fishery.

Let's look at the first point and explore the esthetic and recreational aspect of this situation. No one would argue the esthetic importance of this coastal area—when you pick up a calendar, and one of the months is illustrated by a seacoast photograph, you can be reasonably sure that the scene is somewhere along this coast.

This is the coast that people come from all over the world to look at and to photograph, and as such, it is a national resource in and of itself and a public treasure. Its significance as a recreational resource is reflected in an almost continuous band of State and regional parks along the coast, with public access to the beaches provided at frequent intervals.

The primary mainstay of the many regional economies is recreation, and in Mendocino County it ranks second only to the lumber industry. Studies have shown that in Mendocino County some half a million people visit the coast each year with a cumulative economic impact in excess of \$100 million. The national significance of this coastal recreational resource is reflected here in Point Reyes National Seashore itself, and not so many years ago, at a time when different values prevailed, Lady Bird Johnson upon dedicating the national seashore advised us to be thankful for and treasure this special legacy.

The values that were protected by national recognition of this sensitive area are still here, and have not been diminished by a hasty reordering of national priorities. It is quite clear that the present leasing proposals are in conflict with strong regional and statewide commitments to certain concepts of coastal land management and that as hundreds of millions of dollars have been invested in coastal parklands, a sense of reverence and protectiveness for this special coastline has prevailed.

There are also a number of simple geographic and environmental considerations which make this area particularly sensitive to impacts associated with OCS proposals. The OCS Land Act requires Interior to consider the relative environmental sensitivity and marine productivity of different areas of the OCS—Section 18 (a)(2)(B), but the proposed leasing schedule does not seem to be based on these factors at all; in fact, the schedule provides no ranking of the 22 OCS areas together for comparison of these factors. There are some qualitative comparisons of areas within each of the four overall OCS regions, but nowhere is there any indication that these

comparisons were used to determine the location and timing of lease sales.

Instead, the proposed California sales are defined as such broad areas, that is, the entire California OCS, that relative environmental sensitivity of offshore basins cannot be incorporated in the decision—I think you really can say in spite of the fact that the New Jersey coast is special to you, and that each of us has our special place, that if you weigh relative environmental sensitivity from an esthetic standpoint, and from a biological community standpoint, there are identifiable factors that you could relate to some kind of quantified analysis of an area.

Mr. HUGHES. Mr. Charter, I wonder if you can complete your statement in just a couple of minutes. It is made a part of the record. We have it in full. And I wonder if you could do that so we can get on to the questions.

Mr. CHARTER. I appreciate that. I would like to be able to complete this statement with the same sort of freedom that the other individuals yesterday enjoyed with their testimony. I would like that courtesy, if I could ask for it.

Mr. HUGHES. We want to give everybody an opportunity.

Mr. CHARTER. I understand. I will move right along.

Mr. BURTON. If the chairman would yield, what we are hoping for is to get more information from the questions than from hearing the written document again. We were as bothered as you were yesterday listening to the oil people.

Mr. CHARTER. I understand. Thank you. I am going to move ahead and talk about what constitutes a particularly sensitive area.

If you look at any map of the northern California coastline, you will see a convoluted and rocky coastline dotted with bays, estuaries, coves, and reefs. It is a well known fact that this type of coastal configuration, and its attendant abundance and variety of marine life is the most sensitive kind of environment in the event of an oilspill. Because of the proximity of many lease sale tracts to spawning and breeding grounds, rich tidepool areas, and untouched esteros such as the Estero Americano, and the Estero de San Antonio, it is clear that any OCS development should be directed away from this type of sensitive area, particularly in a nonindustrial coastal region where there has not been a history of previous petrochemical stress in the marine environment.

It is important to note that numerous areas along this coast have been already designated as areas of special biological significance. Endangered species such as the osprey and brown pelican are involved, and the Farallon Islands represents the largest seabird rookery in the continental United States—almost directly adjacent to the Bodega Basin tracts included in lease sale No. 53. In addition, marine reserves exist at Gerstle Cove, Bodega Marine Lab, Tomales Bay, Point Reyes Headlands, Estero de Limantour, and Duxbury Reef as well as the Farallon Islands. The commercial fisheries and coastal birds are treated as most environmentally sensitive, and significant use conflict is projected with seabird life.

It is clear that the existing BLM environmental studies program does not evaluate fully and adequately existing resources. Several studies which are already funded and underway, which will pro-

vide needed baseline data, will not be completed in time to be evaluated for the EIS on lease sale No. 53.

It is clear that areas with the highest esthetic and recreational or biological value must be identified by a coastal resource inventory and should receive special consideration. The full costs of leasing in a given area must be disclosed and the full range of alternatives considered, including a delayed sale, tract deletion, and no sale options.

A lease sale in this region should not even be considered until adequate baseline studies are complete. The existing EIS time frame is undoubtedly too short a period to determine what changes will actually occur in a specific marine ecology. This could lead the EIS to concentrate more on short-term environmental impacts of drilling and spills while neglecting the long-term and more subtle sublethal effects.

In light of a widespread controversy based on these and other factors, how then can we proceed?

How can this committee successfully mediate a truce between local concern which far surpasses anything our area has ever experienced and a fixed and unresponsive program which promises but does not respond to public input in the decisionmaking process?

I think people got the wrong idea at the original call for nominations and hoped that we were going to have something to say about how things are to proceed.

Toward this end I would like to submit four recommendations:

First, an expanded time frame for lease sale No. 53 because of its nature as a frontier area of particular sensitivity and because studies now funded and underway are essential to provide adequate baseline information for a comprehensive EIS.

Second, a comparison of relative environmental sensitivity on a basin-by-basin basis, with deletion from the schedule of basins that have low petroleum reserve potential and high environmental sensitivities.

Third, the EIS should place particular emphasis on identifying impacts which cannot be fully mitigated, such as the potential long-term effects of low-level pollution on fishery resources, or the visual degradation.

Fourth, northern and central California OCS should be regarded as a national security reserve—the lease sale should be delayed until institutional arrangements are created whereby exploration to determine potential reserves can be accomplished without a commitment to actual development. The area should be developed only as a strategic national reserve, with production to proceed only in the event of extreme need. Options such as these hold the potential of permitting a middle path to be achieved with regard to these areas.

In conclusion, I would like to point out that it is one thing to establish a fixed set of priorities in order to meet certain goals, but if the priorities are so rigid that they fail to recognize a place that is so special, so irreplaceable, and so untouched that they proceed anyway in the face of statewide public controversy and in haste make a mistake, then we are, all of us, the poorer. We have right at this moment the situation in the Gulf of Mexico to remind us of the potential magnitude of our mistakes.

We have many other energy options open to us, and in California these options are gaining widespread acceptance. Sonoma County boasts the largest geothermal power complex in the world, currently providing 665 MW. Full development of this one geothermal field is project to be 2,000 MW. So you can see that we are already contributing in a significant way to the national energy mix. Many California counties have adopted or are considering end-use energy conservation codes for buildings—to encourage efficient use of energy and maximum solar utilization. In San Diego when the near shore tracts were deleted from lease sale No. 48, about that time San Diego adopted a strong energy conservation code.

We have an obligation to continue to preserve and respect the special natural heritage of our region, and to remember that we are not yet so desperate that we must burn our cathedrals for firewood.

Mr. HUGHES. Thank you, Mr. Charter. Mr. Burton.

Mr. BURTON. Senator Behr, being one of the few who has had to suffer in the legislative process against bureaucrats, how would you suggest we go about doing these things, assuming we don't want to go through a whole House and Senate fight again?

Mr. BEHR. Well, Mr. Burton, to the extent that responsible Members of Congress make their point of view known to the Department of the Interior, and there is a presumption that all Members of Congress are responsible, you would have the kind of influence, based on the kind of constituency you represent, which goes far beyond myself simply as an individual for the rest of us. And it is my understanding that Congress sets the budgets of all the departments.

Mr. BURTON. But some of the budget-setters are some of the oil exploration people. It is a difficult problem.

How long of a delay do you think is necessary for study completion?

Mr. BEHR. This is a question which should be addressed perhaps to someone else. But I will suggest this—not in my capacity as representing the Marin Conservation League. It has generally been said that the lease sale should be delayed until 1984 because the EIS will not be completed in time for comments to be meaningful. I think the choice does not have to be between 1980 and 1984. Perhaps 1982. So that when the Secretary acts, he will act in a manner based on the best available information, and more importantly, on the comments of persons who have had a chance to study it, including the Governor of the State.

Mr. BURTON. Jerry?

Mr. BEHR. At that time—I don't know!

Mr. HUGHES. Mr. Lewis.

Mr. LEWIS. Thank you, Mr. Chairman.

Susanna Jacob struck a note with me in her testimony, where she talked about representing the small, locally based group of concerned people. I only wish that we could get this number of people at such an important hearing in Washington, D.C.

Mrs. JACOB. Just invite us, and we will come.

Mr. LEWIS. I wanted to mark a note of caution to you in connection with your testimony. You so well described some of the benefits of California, which I have been trying to keep a secret in

Washington. It is somewhat disconcerting to me, because if those folks find out, they will all be out here, then we really have problems.

Dr. Herz, you referred to a number of studies, and the outline of information you presented to us indicated to me that some of that data may very well conflict with material that was presented in the record yesterday, such as the MIT study. I think it would be very helpful to us to balance some of that testimony. If you would provide that information for the record, it would be very helpful to us.

Dr. HERZ. I think one of the problems is—and scientists always say this—that there are not enough data. It is true. I want to read the summary paragraph of this special symposium report that I mentioned earlier: ("Journal of the Fisheries Research Board of Canada," 1978, p. 35):

Our strongest conclusion is that for an adequate understanding of the effect of oil on marine systems we need much more work directed at the properties of the natural systems. This is a problem that is at the heart of environmental protection and that is difficult to solve under the present science policy arrangements. Agencies concerned with the urgent practical problems understandably look for a useful answer on a short term scale. Unfortunately, the marine ecosystems we wish to protect are themselves so complex and their components so richly interconnected that only large scale sampling programs and a long series of observations show meaningful results.

The point I was trying to bring out in my testimony was that a lot of the fate and effects work that the scientific community agrees is needed for the DEIS takes 3 to 5 years to complete. We understand the oil industry's impatience, looking at the scientific community saying, "Wait, wait, we need more data."

But as data start to come in, and again I refer to Dr. Whipple's work, they indicate some very complex interactions starting to come out that suggest that other things that we are putting into the marine environment, like heavy metals, are interacting with and potentiating the effects of oil. These are very, very complicated interactions. I think a lot of the early work which suggested no long term persistent effects was not sufficiently well designed work and it did not look at some of these complex questions.

If in fact we are getting to the point where the amount of oil that exists is seen to be finite and relatively short term, having short term usefulness, it seems to many that it is worth slowing the process down and doing some adequate assessments before going out and doing the work. And I think there are some other items that we can put into the record and would like to do so.

I think that Dr. Hedgpeth—see insert—and Dr. Obrebski, both of whom are familiar with some of the specific local coastal areas, are much better prepared to talk about some of the specific effects right here in this northern California region. But there is much concern, and I think that the information that was conveyed yesterday and the impression conveyed yesterday by Dr. Straughan reflects only one relatively narrow perspective. I do not think there are very many scientists who concur with that oil industry perspective on the effects of oil on the marine environment.

Mr. LEWIS. As you know from the record yesterday, the chairman indicated that our record would be kept open for 30 days. I assume today's hearing is covered as well.

Mr. HUGHES. That is correct.

Mr. LEWIS. So if you send up that material, it will be helpful.

Dr. HERZ. I will take it upon myself to assemble some of the information from a number of people here and elsewhere who are considered to be the experts in these fields, and try to summarize it in a concise fashion so the committee can digest it and use it in the future.

Mr. LEWIS. Staff has indicated that rather than a summary, they would appreciate as complete a base of information regarding those reports.

Dr. HERZ. We will do both. But if you like, we can summarize and provide the originals as well.

Mr. LEWIS. Senator Behr, Mr. Wolfe, Mr. Charter, all directly or indirectly referred to Congressman Clausen's testimony yesterday. Frankly, there was an item in connection with that which I think very much underlies some of the things you were saying; that is, when Congressman Clausen indicated that most recent data from the U.S. Geological Survey estimated that oil potential in this sale area might produce as a mean average guesstimate 548 million barrels of oil, and based upon current consumption rates that would reflect perhaps as much as 60 days of our annual consumption.

And he went on to suggest that the guesstimates relative to natural gas might cover 2 weeks of our consumption. And with that he suggested when you are talking about potential permanent negative impact upon this pristine environment, that we should look long and hard before moving forward too rapidly. That is the bottom line, I think, to much of what you were discussing, Mr. Charter, when you referred to a national reserve.

From there, frankly, I would just like to close any questions or comments I might have by saying, Senator Behr, it is a delight to be with you once again. As always, you are more than articulate, intelligent, and helpful in our contribution.

Mr. BEHR. Those are beautiful words. I will sleep well on them.

Mr. HUGHES. Thank you, Mr. Lewis.

I just want to thank the panel for some very excellent testimony. I think those of you that were at the hearings yesterday know that members of this committee have gotten into these issues very, very deeply. And some of the questioning that took place of all witnesses yesterday I think indicated that this committee does share your concern.

One of the things that was received for the record yesterday were the negative nominations that were submitted by the various governmental units and the State, so that we can examine those and compare them to the findings that the Secretary has to make, whether he accepts or rejects those negative nominations. And I can assure you that we will do a very careful job of looking at those things. Because it is a serious charge that the Secretary is not working in consultation, not working with the local units of government. That was the intent of the Congress. The Congress did not intend to give a veto to the States. But it did indeed intend that a meaningful partnership arrangement be forged. And that is something that we are going to look at very carefully.



Let me just say finally there are a lot of members of this OCS Committee that developed the legislation that have very beautiful areas. Even though the country here is just gorgeous, I can assure you that Gary Studds of Massachusetts shares your concern when it comes to the fishing banks. I share your concern because I have some of the most beautiful wetlands area in my district as well as the Pinelands National Reserve. I can assure you that there are members of this committee that do indeed want the kind of balanced approach to OCS development of which I think all of you speak.

Finally, let me just say that John Burton was responsible for having this buffer set up around Point Reyes. You might know it is the only buffer set up in the entire legislation. And it has created some degree of misinformation and misinterpretation in the legislation. But it also shows you have a very effective Member of Congress representing this district. We are also very pleased to have Jerry Lewis as a new member of the OCS Committee. We know he is going to make tremendous contributions as we continue our oversight function.

Senator Behr, you are so right when you suggest that we Members of Congress perhaps in dialog with the Department of the Interior can do a great deal in trying to bring about the total understanding that is so essential if we are to bring about balance in our decisionmaking. So thank you for your contributions.

The committee stands in recess at this time for lunch. We will be back here at 2:15 p.m.

[Whereupon, at 1:15 p.m., the select committee recessed, to reconvene at 2:15 p.m. of the same day.]

#### AFTERNOON SESSION

Mr. HUGHES. The committee will come to order.

Our next panel is comprised of supervisors. I would like to introduce at this time Supervisor Gary Giacomini, Supervisor Bernard McClendon, Supervisor Erik Hedlund, Supervisor Koenigshofer, and Supervisor Sam Farr.

**STATEMENT OF GARY GIACOMINI, SUPERVISOR, MARIN COUNTY, SAN RAFAEL, CALIF.; BERNARD MCCLENDON, SUPERVISOR, DEL NORTE COUNTY, CRESANT CITY, CALIF.; ERIK HEDLUND, SUPERVISOR, HUMBOLDT COUNTY, EUREKA, CALIF.; ERIC KOENIGSHOFER, SUPERVISOR, SONOMA COUNTY, SONOMA, CALIF.; SAM FARR, SUPERVISOR, MONTEREY COUNTY, MONTEREY, CALIF.**

Mr. HUGHES. First, I would like to welcome our panel of supervisors, and again express my thanks on behalf of the staff and the members for the tremendous hospitality we have received since we have been in California.

We just had a very delightful lunch prepared by the ladies of Marin County Conservation Society, and we are deeply appreciative.

At this time I wonder if we could hear from you, Mr. Giacomini. I might add we would like you, if you would, to summarize your testimony. Your testimony will be made completely a part of the

record. We would like you to keep your comments to around 10 minutes, if you could.

We would like to go through all the testimony so we can get into questions. And the staff will try to give you some indication when we run out of time, when you have about 2 minutes left.

So let's start with you.

#### STATEMENT OF GARY GIACOMINI

Mr. GIACOMINI. Mr. Chairman and members of the committee, I would like to start by first saying on a personal note, and from the hearts of the citizens of Marin County, how deeply, deeply grateful we are that on an issue of this significance you would come here and sit in this room, the Red Baron, in Point Reyes.

I am on the Marin County board of supervisors. And I have the most wonderful district in the State of California. I was privileged this morning to share that with you. As we started that journey at 7:30 in the morning and left San Francisco, we crossed and we experienced all of the treasures that are at risk with this issue. And you were willing to do that. And that is why we are so grateful.

You started at San Francisco Bay. We came up and over the mountain, and down to Muir Beach. The fog could have been kinder, but I think even with it hovering around you could realize the incredible and spectacular experiences of the Marin coast. And then because God was willing and because my constituents wanted it so, the fog lifted in Stinson.

And then we traversed across all the massive Federal holdings that you have all been a part in creating for all posterity, and for all of the people of America.

We went by the fragile lagoon. We traversed Tomales Bay. Finally, we went out and we together got out of that bus and stood on the north end of Ten Mile Beach where you could look and envision what would happen if there were oil platforms 15 miles from that beach.

My own view and my suggestion is that that experience for those 4 hours is probably the most important testimony that is necessary. It says more than any of us at this table or that spoke to you yesterday or today can ever say about the—how fragile, how critical it is that we not sacrifice the most important coast in probably this entire Nation.

VOICE IN THE AUDIENCE. I wonder if you feel an oil rig—

Mr. HUGHES. The gentleman is out of order. We are hearing testimony at this point. If the gentleman will be seated so we can proceed with the testimony.

Mr. GIACOMINI. Because I think, members of the committee, that the coast really presents its own best argument.

You are in a difficult position because you are called to oversee and insure that the Federal OCS regulations are met. You are obligated to meet all the environmental concerns, and at the same time you have to be acutely aware of our own national energy crisis and the need that we must lessen our dependence on foreign imports.

The luxury of simply saying if we were to do that we cannot drill off the coast because we don't want rigs in our backyards is past.

We, the people in this room and you, have to face the fact that our energy needs are real and crucial. We don't want it to seem that we are saying that oil rigs are OK but put them someplace else, put them in southern California.

Our reasons for being opposed to drilling off the coast of Marin and Sonoma, and I speak specifically to them, must be logical and completely unselfish. And I hope what I say will be just that.

It has been debated for a long time how much oil exists in the eight tracts off Marin and Sonoma Counties. The U.S. Geological Survey petroleum estimates establish that the potential yield could be only 8 million barrels off the eight tracts of Marin and Sonoma. Eight million barrels is less than 1 day's national supply of oil.

These figures make our region the lowest of all possible sale areas. It does not seem economically wise for the oil business to spend money on such a small reserve when they can direct their investment to resource areas with much larger reserves.

I am sure you know that there is presently a glut of Alaskan crude oil on the Pacific coast in the absence of pipelines to transfer it to the eastern United States where it is needed.

New offshore rigs would only compound these conditions. Because of transportation costs in money and energy, would the expenditure involved in moving the small reserve of Marin's oil result in anything more than a minimal energy gain?

Another important point to remember is that the low resource potential off Marin offers the possibility that oil will not be transported from these eight tracts by pipeline but by anchored tankers that will lurk off the coast.

As I explained to you this morning, we experienced an oil spill in 1971 by a collision of tankers right off of Stinson.

The northern California oil is thought to be a sour crude variety, high in sulfur. It would require extensive investment in processing equipment to render it usable. Again, I ask, would these expenditures on Marin's small reserve provide anything more than a minimal energy gain?

Keeping these negative aspects in mind, it does not seem consistent that offshore oil drilling should be allowed in an area where the Federal Government has taken such care to nurture and preserve the environment. We cannot ignore the environmental aspects. The economic cost of possible environmental damage and loss cannot be excluded. The Sonoma-Marin coastline and associated environment demand recognition of their uniqueness. This has already been established by the Federal Government.

I will very briefly outline the history of the Federal Government's involvement in this area.

Since 1935 when the Secretary of the Interior requested an investigation and report on the merits of acquiring Point Reyes as a national park, until today when so many are expressing concern over the future of this area, Point Reyes has been a consistent national rallying point for those who hold our Marin-Sonoma coast and its natural values as having the highest priority for protection for future generations.

In 1962, President Kennedy signed legislation authorizing acquisition of this extraordinary 64,000 acre park, but the struggle to protect this park's unique value was still not over.

For 4 years the debate raged over how much of Point Reyes should be declared by Congress as wilderness, and as recently as 1976, you, the Congress, established a 25,370 acre wilderness area and further stipulated that 8,000 additional acres be treated as potential wilderness.

At least 7,500 acres of that potential wilderness area consist of tidelands a quarter mile offshore. The inclusion of the tidelands and estuaries was supported by virtually every bay area and national conservation organization.

You, the House of Representatives, in a committee report on H.R. 8002, stated:

It is the intention that those lands and waters be designated as potential wilderness additions to be essentially managed as wilderness to the extent possible with efforts to steadily continue to remove all obstacles to the eventual conversion of these lands and waters to wilderness status.

It is clear that you were designating the waters of Point Reyes as having extraordinary value.

With the specter of offshore drilling and the possible resulting oil spills, one cannot avoid the question: Is the intent of Congress being ignored by allowing for the possible despoilment of tidelands, esteros, beaches, and lagoons that were recently declared to be a permanent part of our national heritage.

We realize that due to the efforts of Congressman John Burton there has been a Federal exclusion of the actual Point Reyes Wilderness Area tidelands from the least-sale process. But, unfortunately, your action to date does not solve the overall problem.

That exclusion obtained for 15 miles. In the spilloff in 1971, oil was traced as far as 40 miles north and south. And you saw the turbulent waters today off Ten Mile Beach. I think they speak for the fact that 15 miles away doesn't protect our park.

Tracts beyond the exclusion area are proposed and do pose a threat to Point Reyes and the remaining coastal area. The Federal investment in protecting this coast is staggering. A sum of \$60 million was spent on the Golden Gate National Recreation Area, and currently proposed is the development plan for the next 10 years in the amount of an additional \$90 million, a total of \$220 million spent by you in an area that is truly recognized as unique by the Federal Government.

If the estimates of the oil out there are accurate, the oil from all of it would be \$50 to \$100 million less than you spent already.

As I stated in my opening remarks, your position is a tough one. I hope through the facts I have given, you can see that the eight tracts off Marin and Sonoma do not lend themselves to sale environmentally or economically.

Secretary Andrus has said that "viewing the urgent national need to develop internal energy sources to meet our future national needs, all areas of the country must be called upon to contribute to this effort."

Marin County understands this. We are not simply saying do not drill because we do not want oil rigs off our coast. We are committed to helping solve this Nation's energy crisis. We as a county are constantly searching for alternative forms of energy supply.

What we are saying, however, is that this committee and the Department of the Interior take a long, hard, logical look at the

eight tracts off of Marin. We are convinced that you will come to the same conclusion that the Marin County board of supervisors has unanimously come to, they should not be included in lease sale No. 53.

Your conduct and performance in the past has been incredibly impressive and sensitive. We are confident that you will come to the same conclusion that our board of supervisors—by the way unanimously, which here is unusual—have come to.

Finally, I have talked here briefly about the incredible asset of that country that you visited today, those parks and lands. I would like to make a couple of other comments.

You also experienced just tangentially the experience of the towns and communities of this coast of west Marin. They are rugged, they are independent, they are real, and so are the people. The existence of offshore drilling will drastically alter forever the sense of place in the towns and communities you experienced today, and it would do so irrevocably.

I would like to also say this about the people of these communities: I know mine and I know them very well. I have 21 of these communities which you visited a few of today. Look at the people in this room—and they come from most, if not all, of the west Marin communities. And they are saying and they are pleading and they know your historical performance, they know that you are the hope to obviate this tragedy, and they are confident that you will.

Witness the fact that in this community, which is about 600 or 700 people, there are three times as many people in this room as there was in the Plaza ballroom in San Francisco all day yesterday.

I would like as a symbol of how the people feel and feel deeply to do two things, and I don't want to do anything weird, and I won't. I will first read you this, this petition. It is two paragraphs and states:

We, the undersigned, submit the following statement of our position on lease sale No. 53, and we ask that it be entered in the record. We vehemently oppose offshore drilling along the coast of California on the grounds that (1) offshore drilling works to the detriment of the coastal environment and economy, which detriment would be due to large accidental spills, routine, ongoing spills and leaks, the visible presence of rigs, barges and tankers, and their interference with fish boats and other ocean travel.

And (2) the beauty of the coast is priceless, and it would be shameful to risk it for such a small increment to our dwindling supply of fossil fuel when instead we should be turning our limited economic resources toward energy conservation and the development of safe, renewable energy sources.

In addition, if I may, and let me say this—that petition is signed by, in short order, in a day or two, 580 people, circulated in this town. The town's population is 600 people.

[The petition follows:]

#### STATEMENT OF OPPOSITION TO LEASE SALE 53 OFFSHORE DRILLING

We, the undersigned, submit the following statement of our position to be considered in the hearings on Lease Sale 53 and to be entered into the record.

We vehemently oppose offshore drilling along the coast of California on the grounds that:

1. Offshore drilling works to the detriment of the coastal environment and economy, which detriment would be due to large accidental spills, routine on-going spills and leaks, the visible presence of rigs, barges and tankers, and their interference with fishing boats and other ocean craft.

2. The beauty of the coast is priceless. It would be shameful to risk it for a small increment to our dwindling supply of fossil fuel when instead we should be turning our limited economic resources toward energy conservation and the development of safe renewable energy sources.

[The signature sheets were placed in the files of the committee.]

Mr. GIACOMINI. Second, I would like to tender—here are 50 more just in the room—I would like to tender into the record the photographs taken of the oil spill from the accident that I referred to earlier in 1971. They should be, and I know they will be, looked at and studied carefully by you.

[The photographs follow:]



Volunteers filling a truck with sludge and oil after the collision of two oil tankers on the San Francisco Bay on January 21, 1971. A road had to be constructed to get the trucks down on the beach and still remains today. It took days for the volunteers to clear away the large clumps. Small patches of oil remained in the tidal pools and on the beaches much longer.



Hand of a volunteer who helped clean up the beach after the San Francisco Bay oil spill in January 1971.







Dead bird found in a clump of oil on a northern California beach about 15 miles from where the two oil tankers collided in San Francisco Bay in January 1971.

Mr. GIACOMINI. And finally, I would like to read a statement by Secretary Andrus, the Secretary of the Interior. This is in a book recently published, called *Wilderness Next Door* and I think it came out last week. We were able to give each of you a copy of this as we were on the bus this morning.

[Copies are on file in the Committee Offices.]

I would like you to focus on page 1 which is the forward, and I would like you to remember this quote by the Secretary. It is about this area. It states:

Ultimately, one thing that will insure this country's rich legacy of natural, historic and recreational treasures will continue to be protected and enhanced is a deep sense of pride and ownership. That is what this is all about, the attitude evident in the people who saved and shaped this wilderness.

That attitude is deep and pervasive. And I urge you, this committee, to have the Secretary abide by his own words and strike these tracts forever from lease sale No. 53.

[The prepared statement follows:]

#### TESTIMONY OF SUPERVISOR GARY GIACOMINI

Mr. Chairman, members of the committee, I come before you in a unique position. I represent the Marin County Board of Supervisors who have voted to oppose drilling off Marin's coast, unanimously. Believe me, gentlemen, that is unique.

During the past few days you have seen a spectacular portion of Northern California's coast. Its pristine and untouched beauty is obvious. The coast is its own best argument for why it should be carefully protected. Your task is extremely difficult. You are called upon to oversee and insure that the federal OCS regulations are met. You are obligated to meet all the environmental concerns and at the same time must be acutely aware of our own national energy crisis and the need to lessen our dependence on foreign imports. I do not envy your position. The luxury of simply saying we cannot drill off the coast because we don't want rigs in our backyard is past. We have to face the fact that our energy needs are real and crucial. We also do not wish it to seem that we are saying "oil rigs are okay; put them in Southern California and we are all for them." Our reasons for being opposed to drilling must be logical and they must be completely unselfish. I hope the following will be just that.

It has been debated exactly how much oil exists in the eight tracts off Marin and Sonoma Counties. The United States Geological Survey petroleum estimates establish that the potential yield could be only 8 million barrels off the eight tracts of Marin and Sonoma. Eight million barrels is less than one day's national supply of oil. These figures make our region the lowest of all possible sale areas. It does not seem economically wise for oil business to spend money on such a small reserve when they can direct their investment to resource areas with much larger reserves. I am sure you know that there is presently a glut of Alaskan crude oil on the Pacific Coast in the absence of pipelines to transfer it to the eastern United States where it is needed. New offshore rigs would only compound these conditions. Because of transportation costs in money and energy, would the expenditure involved in moving the small reserve of Marin's oil result in anything more than a minimal energy gain? Another important point to remember is that the low resource potential off Marin offers the possibility that oil will not be transported from these eight tracts by pipeline but by anchored tankers that will lurk off the coast. The northern California oil is thought to be a sour crude variety, high in sulphur. It would require extensive investment in processing equipment to render it usable. Again, I ask, would these expenditures on Marin's small reserve provide anything more than a minimal energy gain?

Keeping these negative aspects in mind, it does not seem consistent that offshore oil drilling should be allowed in an area where the federal government has taken such care to nurture and preserve the environment. We cannot ignore the environmental aspects. The economic cost of possible environmental damage and loss cannot be excluded. The Sonoma-Marine coastline and associated environment demand recognition of their uniqueness. This has already been established by the federal government.

I will very briefly outline the history of the federal government's involvement in this area. Since 1935 when the Secretary of the Interior requested an investigation

and report on the merits of acquiring Point Reyes as a national park, until today when so many are expressing concern over the future of this area, Point Reyes has been a consistent national rallying point for those who hold our Marin-Sonoma coast and its natural values as having the highest priority for protection for future generations. In 1962, President Kennedy signed legislation authorizing acquisition of this extraordinary 64,000 acre park, but the struggle to protect this park's unique value was still not over. For four years, the debate raged over how much of Point Reyes should be declared by Congress as wilderness, and as recently as 1976, you, the Congress, established a 25,370 acre wilderness area and further stipulated that 8,000 additional acres be treated as "potential wilderness." At least 7,500 acres of that potential wilderness area consist of tidelands a quarter mile offshore. The inclusion of the tidelands and estuaries was supported by virtually every Bay Area and national conservation organization. You, the House of Representatives, in a committee report on HR 8002, state "It is the intention that those lands and waters be designated as potential wilderness additions to be essentially managed as wilderness to the extent possible with efforts to steadily continue to remove all obstacles to the eventual conversion of these lands and waters to wilderness status." It is clear that you were designating the waters of Point Reyes as having extraordinary value.

With the specter of offshore drilling, and the possible resulting oil spills, one cannot avoid the question: Is the intent of Congress being ignored by allowing for the possible despoilment of tidelands, esteros, beaches and lagoons that were recently declared to be a permanent part of our national heritage. We realize that due to the efforts of Congressman John Burton there has been a federal exclusion of the actual Point Reyes Wilderness Area tidelands from the lease-sale process. But, unfortunately, your action to date does not solve the overall problem. Tracts beyond the exclusion area are proposed and do pose a threat to Point Reyes and the remaining coastal area. The federal investment in protecting this coast is staggering. Sixty million dollars was spent on the Point Reyes Seashore and wilderness area; another \$70 million on the Golden Gate National Recreation Area; and currently proposed is the development plan for the next ten years in the amount of an additional \$90 million—a total of \$220 million, spent by you in an area that is truly recognized as unique by the federal government.

As I stated in my opening remarks, your position is a tough one. I hope through the facts I have given you can see that the eight tracts off Marin and Sonoma do not lend themselves to sale environmentally or economically. Secretary Andrus has said that "viewing the urgent national need to develop internal energy sources to meet our future national needs, all areas of the country must be called upon to contribute to this effort." Marin County understands this. We are not simply saying do not drill because we do not want oil rigs off our coast. We are committed to helping solve this nation's energy crisis. We as a county are constantly searching for alternative forms of energy supply. What we are saying, however, is that this Committee and the Department of Interior take a long, hard logical look at the eight tracts off of Marin. We are convinced that you will come to the same conclusion that the Marin County Board of Supervisors has unanimously come to—they should not be included in Lease Sale No. 53.

Mr. HUGHES. Thank you, Supervisor Giacomini.

Supervisor McCLENDON. Likewise, your statement is a part of the record. We would appreciate your trying to hit the highlights for us.

#### STATEMENT OF BERNARD McCLENDON

Mr. McCLENDON. Thank you, Congressman Hughes, Congressman Lewis, members of the panel. There are two points that I would like to clarify.

First, one, I deeply envy my colleague, Supervisor Giacomini, for his very eloquent delivery. I am very envious of that particular ability, which I do not have. But I can counter it by saying that while he may represent a very lovely part of California, that for more than a half century I have been led to believe that the hub of the universe is Del Norte County.

Mr. HUGHES. We understand that sense of pride.

Mr. McCLENDON. My name is Bernard McCleendon. I am presently chairman of the Board of Supervisors of Del Norte County, State of California. I am honored and pleased to be able to appear before you today to represent delightful Del Norte.

Mr. Chairman, I will try and make my appearance short and to the point, take no more time from this hearing than that to be able to present the following.

Having been privileged to live in the delightful confines of north coastal California for a half century, I have been able to recognize, enjoy, evaluate, and appreciate the natural resources nature has generously allotted to this part of the continent.

There are few places in the world that are endowed with beautiful ocean, clear flowing streams, tree-covered land areas of superlative growth, and air of pristine quality. All of these natural resources assist in enriching living qualities of the fortunate few who reside and are our visitors to this areas.

But it is not enough to have and enjoy the privilege of the enchanting environment and still be able to maintain a high standard of social and economic distinction. A resource should be utilized to the practical side of daily demands.

I do not suggest, nor do I mean to imply, that resources should be imprudently exploited. Rather, they should be judiciously utilized to the maximum benefit of the greatest number of people.

Where nonrenewable resources are a consideration, prudence dictates that the benefit derived be carefully considered against the damage to the environment and the complete ecosystem. Justification for any development must be founded for each issue.

I do not consider myself an alarmist. But I do believe in the reality and I recognize certain needs in sustaining our present and our anticipated demands for the needs of the home and family.

To balance our energy requirements and to keep the cost of energy within acceptable limitations, it appears to me to be prudent and proper to permit exploration and possible development of potential gas and oil that may be deposited in the Outer Continental Shelf under lease No. 53.

The board of supervisors of delightful Del Norte are keenly aware of the superb quality of our natural resources and their value to the area and to all mankind. It is our desire and intent to afford maximum care and consideration in protecting the heritage that has made us the envy of California's other 57 counties less generously endowed by a bountiful nature.

We also are cognizant of economic demands necessary for leadership survival. Among the demands are constantly expanding uses of energy, including natural gas and oil. If there appears prospect of this resource being harvestable within the OCS off delightful Del Norte, we support and encourage the exploration and development.

We ask, no, we demand, that reasonable cooperation be implemented to assure that our policy of using resources wisely and with as little disturbance or damage to the environment be consistent with our social and economic demands.

Mr. Chairman, it is gratifying to me to be aware of the fact that we here in this glorious country can meet and express our views, our knowledge and opinions no matter how divergent they may appear or how contradictory they may be to another's testimony.

It is through the exchange of experience, opinions, and knowledge that we grow in wisdom. As long as we can continue to expand and grow in our wisdom, we as individuals and our society as a whole continue to grow and prosper.

Mr. Chairman, I humbly pray that our society will grow and thus survive to pass on this wonderful heritage to our future generations.

Thank you.

Mr. HUGHES. Thank you, Mr. McClendon.

We are going to depart from normal procedure because Supervisor McClendon has an 8-hour drive. So at this time, Mr. Lewis, do you have any questions of Supervisor McClendon?

Mr. LEWIS. Mr. Chairman, I can't say I have any questions per se, except that I was very impressed by the balanced approach the supervisor has taken to what is a very delicate question, especially coming from Del Norte.

I would like to share with you just one item, and that is that the problem of energy resources, the reality of our resources being finite, is not a new problem. It has been around for I don't know how many decades.

But the amazing thing about serving in public affairs, as you know, is that we are a crisis-oriented society. And people tend to react only when a crisis occurs, such as when there are gasoline lines.

The thing that occurs to me is that I think all of us should try to evaluate and share and do something about the fact that the folks out there seem to be willing to drive their cars no matter what.

They are paying \$3 a gallon in Israel. They are paying a little more than that in Cyprus, and almost \$4 a gallon, and still driving, in Athens. So the folks are going to drive those automobiles.

It occurs to me, in terms of that crisis that may be ahead, unless we bring some sense to this while the crisis is here, the mass of those people who almost insist upon a car regardless may take our environment away from us and run with it unless we insist upon some long-range planning, some comprehensive programing, that some way short circuits that crisis while it is before us.

That is very much a part of what we need from your people as well as your advice and counsel and assistance.

Mr. McCLENDON. Congressman Lewis, we can only profit by past mistakes or from the experience of somebody else. We in delightful Del Norte feel that before locking the door, we want to make sure that the choice we make is correct.

And while we certainly are not going to willingly permit the permanent damage to our environment, that is too precious a heritage to sacrifice for even a demand for other resources.

We want to explore the possibility of all phases of energy. And, again, I repeat, we don't want to lock the door. We try to be prudent in our determination of what is best. And then if we fail, we can have the consolation of knowing that what we did, that the decision we made was based upon what we felt was right.

Mr. LEWIS. Thank you, Mr. Chairman.

Mr. HUGHES. Thank you, Mr. Lewis.

Supervisor McClendon, I think that the criticisms that we heard today fall into about three major categories.

One is that the Department of the Interior is not consulting, not listening to the negative nominations of the local and State governments—and I might add that that comes not just from California, but other parts of the country have directed the same criticism in the past to the Secretary of the Interior. In essence, local concerns say they are not being heard or addressed in accordance with the intent of the Congress when we passed the Outer Continental Shelf Lands Act.

I wonder if you can tell us if your county directed negative nominations, if you expressed some concerns, either through the governor's OCS policy committee or directly to the Secretary of the Interior?

Mr. McCLENDON. Yes, Congressman. For the past several months we in Del Norte County have been both informed and questioned about proposed offshore development, the Secretary of the Interior and his office as well as from the State office of resources in California.

And there has been a fund of information generated, both to support the OCS sale 53 as well as to safeguard the environments that are certainly in jeopardy.

And I have tried, my coworkers have earnestly tried, to arrive at as much information as we could, both for the benefit and the potential dangers of OCS where it would affect Del Norte County.

So I can say that I think that we are at least informed that there are two sides to the coin, and the decision that we have arrived at is based upon our best judgment from the evidence that has been presented to us.

Mr. HUGHES. Did you find that your concerns were not being addressed by the Secretary of the Interior?

Mr. McCLENDON. I can't truthfully say that they were ignored. I think that the Secretary of the Interior did give us consideration.

Mr. HUGHES. I appreciate your candor. I know that is not going to be a very popular line of testimony. But it is important to us because we have heard the same concerns before.

There are many of us in the Congress that would like to have seen a more meaningful role for the States. But we recognize that you have to have one national policy. And what we tried to devise was a scheme that would enable local units of government and the States to submit through negative nominations and other comments suggestions that would address local concerns.

And that is one of the areas that I think gives this committee the most serious concern.

There are other areas that concern us also. There is the suggestion that perhaps some of the areas outside of the Santa Maria Basin, for instance, show very little hydrocarbon potential. And that is a matter of prioritizing.

And, of course, it was the intent of the Congress that the Secretary, in devising lease schedules, would endeavor through the leasing program to identify those areas with highest potential and least environmental risk so that we could indeed have some rational program for leasing throughout the country in the Outer Continental Shelf.

I might add that every area of this country has precious natural resources that are placed in jeopardy, whether you are talking

about the Georges Bank area, and its very bountiful fishing grounds, or whether you are talking about the Mid-Atlantic region, where I am from, where we have a beautiful tourist industry—it is the second largest industry in our area of the country. We pride ourselves on our sandy beaches and beautiful water and our pristine wetlands. And we are concerned, too.

One of the things I hope will come out of this hearing will be a better working relationship between the Federal Government and the States and the local units of government.

So I sincerely appreciate your candor.

Mr. McCLENDON. Thank you.

Mr. HUGHES. Thank you. You may be excused at this point. We understand you have a long drive. And we thank you for your testimony.

Mr. McCLENDON. Thank you.

[The prepared statement of Mr. McClendon follows:]

STATEMENT OF BERNARD McCLENDON, CHAIRMAN OF THE BOARD OF SUPERVISORS  
OF DEL NORTE COUNTY, STATE OF CALIFORNIA

I am honored and pleased to be able to appear before you representing "Delightful Del Norte." I will try and make my appearance short and to the point and take no more of the hearings time than to present the following:

Having been privileged to live in the delightful confines of the Northern California coastal area for nearly half-century, I have been able, in spite of myself, to recognize, enjoy, evaluate and appreciate the natural resources nature has generously allotted this part of the continent. Few places in the world are endowed with clear flowing streams, tree covered land areas of superlative groves, and air of pristine quality. All of these natural resources assist in enriching living qualities of the fortunate residents and visitors to the area.

It is not enough however, to have and enjoy the privilege of the enchanting environment and still be able to sustain a high standard of social and economic distinction. A resource, unless utilized, serves only the aesthetic purposes which may be pleasing to the senses, add little or nothing to the practical side of daily demands. I do not suggest, nor do I mean to imply that resources should be imprudently exploited. Rather that they should be judiciously utilized for the maximum benefit of the greatest number of people. Where non-renewable resources are a consideration, prudence dictates that the benefit derived be carefully considered against the damage to the environment and the complete ecco system. Justification for the development formed on each issue.

While I do not consider myself an alarmist, I do believe in reality and recognize certain needs in sustaining our present and anticipated demands for needs of the human family. To balance our energy requirements and to keep the cost of energy within acceptable limitations, it appears prudent and proper to permit exploration and development of potential gas and oil deposits within the outer continental shelf as may be possible in Lease Sale #53.

The Board of Supervisors of "Delightful" Del Norte County are keenly aware of the superb quality of our natural resources and their value to the area and all mankind. It is our desire and intent to afford maximum care and consideration in protecting the heritage that has made us the envy of California's other 57 counties less generously endowed by a bountiful nature. We also are cognizant of economic demands necessary for leadership survival. Among the demands are constantly expanding uses of energy, including natural gas and oil. If there appears prospects of this resource being harvestable within the OCS off "Delightful" Del Norte, we support and encourage said exploration and development. We ask only that reasonable cooperation be implemented to co-operate with our policy of using the resource wisely and with as little disturbance or damage to the environment consistent with social and economic demands.

Mr. HUGHES. Supervisor Hedlund.



## STATEMENT OF ERIK HEDLUND

Mr. HEDLUND. Yes. I am Supervisor Erik Hedlund from Humboldt County. As you note, there are no statements on record from me, but I will keep my remarks brief and I will prevail upon the 30-day period you allowed for further testimony being submitted.

Honorable members of the committee and distinguished guests and staff, fellow panelists, and other concerned participants in these hearings, it is a privilege for Humboldt County to have an opportunity to express our concerns regarding the pending lease sale 53, the 1978 amendments, and the 5-year lease program.

I might say that Humboldt County is situated immediately to the south of Del Norte County. We, of course, are humble Humboldt County.

Mr. HUGHES. Delightful Del Norte County.

Mr. HEDLUND. I am sympathetic with Supervisor McClendon's drive, because I kept tally of the gas vouchers as I came down here, and I was thinking about how much money people must spend coming to events like this, and how much gas must be consumed. In my case, I consumed something like \$40 worth of gas, and driving back will probably do the same—though I am not going by way of Sacramento this time, so it may be a more direct route.

If local jurisdictions often say they are special or unique, it is no less true because everyone says it. At this point I would have liked to have shown you slides of Humboldt County. But I see there is not really provision for that. And you probably have seen similar scenes many times in the past. I will just say that we have 135 miles of stirring coastline. That is much more coastline than many States have. And we range in land form from sensuous dunes, through steep rocky escarpments, the primitive tatoo of the Pacific Ocean on our geologically recent shores. If I did have the slides, they would show you a scene of relatively pristine beauty, as Congressman Clausen commented yesterday.

Our area was settled about 150 years ago. The improvements that we Western European civilization has made in the last 150 years are relatively recent. And you can see where they have come from, and where they are bound for I suppose.

The national appetite for oil and gas must be balanced against our local interests. When you revised the 1953 legislation, we were concerned about the loss that local governments seemed to suffer by having to focus their concerns through the Governor's Office. It is not that we feel that the Governor's staff is unresponsive. But when you have 135 miles of coastline, it is somewhat difficult to feel that the resolution or the focus, the scale you are looking at a problem, can be adequately met by going through those series of steps. You will understand that even if you may not agree with it.

Mr. HUGHES. I may say I do agree. In fact, I would much prefer to have given the local units of government more of a direct relationship, because I find even in my own State that often the Governor doesn't represent the views of one particular area of the State as actively as he should. So I am sympathetic. But we lost.

Mr. HEDLUND. Please do not interpret my comments as in any way a criticism of the Governor's Office. We fully supported Denny Green's testimony before your committee at the turn of the year

when she commented to the combined committee of the Senate and the House on the amendments.

The national appetite for oil and gas must, however, be balanced against local units. And we hope that the mechanisms can be discovered for that.

In our case, we felt the concern was adequately reflected in the original legislation and we are not so certain about the present legislation probably by virtue of our experience to date.

Humboldt County is somewhat north of Los Angeles, where BLM has its offices. We are even fairly far enough north of Ukiah, where the most recent meetings were held today. We have had one meeting in Humboldt County to collect data.

Humboldt County is an area geologically distinct from Marin and Mendocino and Sonoma counties. In fact, the area north of the Mendocino escarpment to the Oregon border is an entirely different geologic plate. But it is all included in the same lease sale.

Humboldt County did make negative nominations over the whole length of our coast. Most of those were accepted, I think primarily because the area is not an area of high potential for oil, as I understand it. Though I understand also Mr. Ogle of the private consultants does suspect that there may be oil reserves off our coastline.

The potential for gas is much more well developed.

I accept Mr. Clausen's characterization of the total potential, however, and do question whether the investment that is necessary and the risks that are involved in drilling in 1,200 feet, which is what you would have to do in the Eel River Basin, are merited by the reserves that are known at this time. But I am not a geologist.

Our interest locally is that we would like to see oil development balanced and include further developing of our shipping and trade with other nations. We do have a harbor facility; increased harvest yield from our rich marine fishery, and full capitalization on the tourism potential of the sports and recreation industry in the area. For the entire north coast, tourism is a significant factor of the economy, and in our county it is our second most important factor.

Our primary industry is timber production, which in one sense we feel we are already making a contribution to the energy status of the Nation by producing timber. That is one of the most effective ways of harvesting solar energy, in the building materials, to help the entire economy.

Local control and full development of our local economic potential and protection of the coastal environment are the watchwords of the Humboldt County Board of Supervisors in protecting the trust that our constituents have placed in our hands.

A particular concern we have is that the EIS process will not adequately identify potential hazards to the full use of our rich coastal area and will not be able to adequately specify mitigation measures necessary to protect our quality of life and allow full economic development of all of our resources. At a preliminary public meeting one staff person from BLM indicated he felt adequate information was in hand to publish a legally adequate EIS.

Our feeling is that this is very far from being the case. And the spirit of EIS, of the NEPA guidelines, is certainly thwarted by that kind of an approach. In other words, we don't just want a legally

adequate EIS or assessment of the threat to our coastline. We want an accurate assessment of it.

I had the opportunity to review a paper that was submitted to you by the geologist with Chevron. I believe it was presented by someone from Chevron yesterday. And it makes a series of observations which I feel, if it is appropriate at this time, I would like to take some exception to.

It makes the observation that the sea state is not a serious concern of the north coast area. I would like to say Mr. McClendon would be aware that the sea state is a serious matter. During the 1960 earthquake, the tsunami wiped out Crescent City. I think you are aware of that.

The particular area of the coast of Humboldt County between the Mendocino escarpment and Patrick's Point is a weather system that generates in a matter of 6 hours, can entirely change the direction—there are three major current systems. The Dave's current, the oceanic current, and the summer current. These affect the upwelling patterns in the sea. And in 6 hours you can change the prevailing plume from the Eel River, which is the basin that would probably be explored the most, and you can change the prevailing plume as viewed from aerial photos from heading south to heading north.

The volume of water coming out of the Eel River and the volume of sediment is greater during its peak flows than that of the Mississippi River on an average. In other words, it is a river that carries a lot of stuff out there and drops it. And that plume, change in the direction of that plume, is a real change in the physical environment out there. You can change that direction in 6 hours through the storms generated in that area.

The entrance to the harbor was designed for 40-foot waves—the bar that the Corps of Engineers designed for us. On record in 1913 is a 100-foot wave that took out the lighthouse at Trinidad Head, a significant scenic feature in our area. Sixty-foot waves beat against that rock last year.

What I am saying is that many oceanographers say that the sea states in the vicinity between Patrick's Point and the Mendocino escarpment rival or exceed those of the North Sea. According to Kassel, that was not a moot question—it is at least a moot question.

There were 20 wells drilled in 1963 through 1967. Kassel's and an associate of his report on those in the statement yesterday. They said there were no problems recorded. But in their paper itself, the report which was apparently submitted to you, they note that there were numerous shutdowns due to the weather.

I would add that the weather in our area is such that every year many fishermen lose their lives. It is an occupational hazard, but it is no less of a tragedy for that. It is also perhaps an occupational hazard working on the oil rigs. During the times when we have the high sea states, it is impossible for the Coast Guard to launch through our harbor. The nonsinkable Coast Guard boats often capsize. In fact, we lost a couple of men off a Coast Guard cutter last year. The helicopters cannot get out to rescue anybody.

What I am saying, if somebody is out there on a rig in time of trouble, when there is a heavy sea, it is unlikely that anybody can

get out there to help them, from what we can tell. That is local input. There may be experts that can testify otherwise. But that is what it looks like to us.

I would just add on the geology that the plate tectonics of that area, we have a down-thrusting plate. We are north of the San Andreas fault. But portions of it do come onto our area. What we have is a different kind of fracturing pattern. It has only been recently developed, the information. It appears that we have a fracturing pattern that is more like if you crack an egg shell. We have a very high seismicity activity in the area, and the fault locations are often changeable. There are some established fault lines. But new stuff is happening all the time.

The turbidity of the Eel River is such that it drops a lot of mud in the Eel River Valley or basin that is proposed for development, and it is my understanding that BLM now is doing some geologic studies to determine the hazards of slides in that area. The preliminary information is that it is very hazardous indeed. I would hope that all of this kind of information would eventually be in an EIS.

And I question the scheduling. There are no good oceanographic stations from Port Mendocino to the Oregon border. So that whole area is generally conceded to have—there are gaps in knowledge there, perhaps more excessive than any other OCS areas. And we would hope that the schedule for letting leases would allow full assessment of the potential for geologic disturbance affecting the drill sites, and also for the assessment of the effect of the seas.

The final point I would like to make is that our fishing industry is an important industry there. It is a relatively undeveloped resource. Our oyster industry develops 50 percent of the oysters and ships to market 50 percent of the oysters that come from the State of California. Our salmon industry, we have the Klamath River, which I am sure you have heard of. It is in my district.

We have Redwood National Park, which is an area that the government has made a significant investment in. The State of California has made significant investments all up and down our coastal area. So the coastline, as has been observed here in the Marin County area, is an area that other public moneys have been invested in. And we would hope that no action would ignore that.

In our fishing industry, it is an industry that has a great potential for development. The questions have been raised in Prudhoe Harbor about the effect on the migratory behavior of salmon of trace amounts of petrochemicals, which raise questions in our mind about the advisability of encouraging abnormal rather than seepage, as you know releases of petrochemicals in the ocean environment, suspended gas. Depending upon who you consult, apparently has an effect on the migratory behavior of salmon.

Thank you for allowing me to testify.

Mr. HUGHES. Thank you, Supervisor Hedlund. Supervisor Koenigshofer.

#### STATEMENT OF ERIC KOENIGSHOFER

Mr. KOENIGSHOFER. Thank you. I have a letter that was submitted by Michael Gage, state assemblyman. He would like to put it in the record.

Mr. HUGHES. Without objection, it will be received.

[The information follows:]

ASSEMBLY,  
CALIFORNIA LEGISLATURE,  
August 28, 1979.

Hon. JOHN M. MURPHY,  
*Chairman, Select Committee on the Outer Continental Shelf,*  
*Washington, D.C.*

DEAR CONGRESSMAN MURPHY: California's North Coast is one of the world's most beautiful natural resources. The risks of offshore oil drilling along the North Coast far outweigh the benefits.

The U.S. Geological Survey ranks the Central and Northern California Outer Continental Shelf low in terms of petroleum resources—16th out of the 22 proposed leases. In addition, the Department of the Interior defines California's north and central coasts as environmentally sensitive, most notably in the areas of commercial fisheries.

Outer Continental Shelf oil leaseholds along the North Coast would be environmentally and economically unsound. A large oil spill or leak similar to the current disaster in the Gulf of Mexico would irreparably damage the North Coast's beaches, estuaries, and fisheries. Conventional cleanup of oil slicks and beaches would be impossible, as North Coast beaches are generally inaccessible.

In addition, a major oil leak would threaten the North Coast's abundant marine life, including the migratory patterns of the magnificent California gray whales. Thousands of migratory waterfowl and the sanctuaries which they frequent would also be jeopardized.

The fishing industry is a key feature of the North Coast's economy and provides a livelihood for thousands of North Coast residents. Large-scale offshore drilling would be a direct threat to North Coast fisheries, particularly in the event of a major oil spill which could devastate the region's economy.

The risks of offshore drilling along the North Coast are intensified by the geological instability of the area. The combination of offshore oil rigs and earthquakes is a formula for disaster.

In my view, the economic and environmental risks of the Department of the Interior's proposed North Coast leaseholds are unacceptable. Consequently, I respectfully urge the House Select Committee on the Outer Continental Shelf to delete Lease Sale #53 from the Department of the Interior five-year outer continental shelf plan.

Sincerely,

MIKE GAGE.

Mr. KOENIGSHOFER. I am Eric Koenigshofer, a member of the Sonoma County Board of Supervisors. I am pleased to see that you are getting a very accurate taste of the Sonoma-Marin experience by having a dog walking around the room while we are having this hearing.

Supervisor McClendon mentioned that there were two sides to every issue, two sides to the coin. And I would say that that certainly is true. In a certain sense this may be the Susan B. Anthony dollar of the energy issues—at lease sale No. 53.

I represent 60 miles of the California coastline almost directly above us. Additionally, I am chairman of the north central region of the California Coastal Commission, which includes the coastal zones of San Francisco, Marin and Sonoma Counties.

On behalf of the Sonoma County Board of Supervisors and the people I represent, I would like to thank you for making yourselves available to us so that we may have direct input regarding the proposed Outer Continental Shelf Lease Sale No. 53. As an elected, local official, this opportunity is welcome due to the frustration I have experienced in trying to deal with the Federal bureaucracy. Up to today I have felt that the momentum behind lease sale No. 53 has pushed it along with little or no regard to local government input or concern. I hope that the results of your hearings and

subsequent action related to the proposed lease sale will alter my view.

As you are undoubtedly aware, California has demonstrated commitment to the care and preservation of our coast. The people of the State of California spoke directly of the importance of coastal preservation by passing proposition 20 some years ago. As a matter of fact, that initiative process originated out of concern over development along the Sonoma coast. I mention this only to bring to your attention the importance placed upon recreational value, resource protection, and a continuation of the existing healthy coastal economy, by the people of California. That concern is very much alive in this region of the California coastline.

The people of the county of Sonoma, the Sonoma County Board of Supervisors, and the north central region of the California Coastal Commission object to lease sale No. 53, especially to those areas being considered within our area, on a variety of grounds.

May I first speak to our general objection to lease sale No. 53. The development of offshore oil will conflict throughout the lease sale area with recreational uses and with the commercial fishing industry. Additionally, the State and Federal Government have made substantial investments of public funds in park land in the area. The inadequacy of available data presents unwarranted risks to these resources and public investments. Furthermore, the fact that the west coast finds that there is a glut of oil currently. We cannot now store, refine, or distribute our current oil supply on the west coast. What sense does it make to push an untimely, premature lease sale ahead when the crude would likely be marketed to Mexico or Japan?

I would now like to briefly outline for you the specific objections of Sonoma County to lease sale No. 53; in particular, that area found off of the Marin-Sonoma coast.

First, development of these tracts is inconsistent and incompatible with all present and anticipated coastal zone land uses. The Sonoma County general plan, while encouraging industrial development, restricts this development to already urbanized areas. Furthermore, the plan gives priority to those industries which rely upon development of renewable resources including agriculture, forestry, fishing and tourism. Our plan places special emphasis upon preservation of fisheries, tourism, agriculture, and forests.

The Sonoma coastal zone lacks the housing, labor and transportation base to support industrial development. Both the California coastal plan and the county plan make it clear that State Highway No. 1, the major coastal arterial road, should remain a 2-lane, rural scenic highway. Costs of road improvements to this remote area would be prohibitive because of the rugged topography and widespread geologic hazard. Use of this road for offshore oil-related activities would preempt road capacity committed to tourism, agriculture and timber uses.

I would like to briefly make reference to the comments submitted by Mr. Kassel, employee of Chevron Oil Co. and their chief geologist, who casually dismisses the following concerns expressed by our county and others. The arrogance of the industry in this matter is astounding to me.

Bodega Harbor, the county's only commercial boat anchorage, contains no excess capacity sufficient to accommodate oil and gas-related development and is reserved for use by the local fishing fleet. Existing marina facilities have proven so inadequate that new ones have been planned to ease crowded conditions in the harbor and to encourage the fishing industry. Development of the harbor to service offshore oil and gas production would displace fishing facilities. This is unacceptable both to the county general plan and the California coastal plan.

Thus, if offshore oil and gas development occurs off of the Sonoma coast, it will most likely do so without benefit of onshore support facilities located in Sonoma County.

Second, migrating species of anadromous fish and rare marine mammals cross the proposed lease area. Bureau of Land Management maps indicate the presence of anadromous fish in Sonoma coastal waters migrating to spawning grounds in the Russian River, Gualala River, Salmon Creek, San Francisco Bay Watershed and other coastal streams. Rare humpback and gray whale regularly migrate through these waters. The proposed lease sale area also provides habitats for numerous species of pinniped and dolphin.

Third, the negatively nominated area is subject to geologic hazards. The San Andreas Fault runs along the Sonoma shoreline, as close as 3 miles from possible leasing areas. Other smaller faults occur within the leasing area itself. As a matter of fact, the epicenter of the 1906 San Francisco earthquake was located in the Bodega Bay area. These hazards could present an unacceptable potential for environmental damage.

Fourth, oil and gas development may adversely affect air quality in this region. Although the current uncertainty over regulation of OCS-generated air pollution may dissipate by the time development occurs in the OCS No. 53 area, offshore activities may impede achievement of Federal and State-mandated air quality standards in Sonoma County. Prevailing winds from the northwest, as well as local sea breezes, will direct offshore pollutants onshore. The Bay Area Air Pollution Control District, which includes southern Sonoma County, is currently classed as a nonattainment area. Air pollution generated off the Sonoma County coast could also degrade air quality in the Point Reyes National Seashore and Golden Gate National Recreation Area.

Fifth, the area being considered for lease sale off the Sonoma-Marine coast has limited petroleum resource potential. Of the five sedimentary bases in the lease sale No. 53 area, the Bodega Basin has the second lowest oil-producing potential and the lowest gas-producing potential.

Sixth, development of offshore oil in this area would adversely affect Sonoma County's scenic coastal resources. Our general plan accords scenic resources the same priority accorded more tangible resources such as agricultural land, forests and fisheries. Our plan and the California coastal plan designate the entirety of Highway No. 1 as a scenic highway.

Seventh, the presence of offshore oil development apparatus will interfere with the commercial fishing industry. Our chief concern is the danger of oil spills or seepage. In addition to the oil which is obvious on the surface of the ocean from such accidents, we know

that sludge settles to the bottom adversely affecting an area's ability to sustain marine life. A report to the President by the Council on Environmental Quality in April 1974 cited five major impacts the presence of oil can have on shellfish and finfish:

One, eggs and larvæ die in spawning and nursery areas from coating or exposure to concentrations of hydrocarbons.

Two, adults, particularly anadromous species like salmon, can be prohibited from reaching critical spawning areas in freshwater habitat.

Three, spawning areas are contaminated.

Four, fecundity and spawning behavior are altered.

Five, local food species, lower on the food chain, are affected and their contamination is passed on as they are preyed upon.

I would also like to point out to you that Sonoma County already bears its fair share of providing the Nation's energy requirement. The world's largest producing geothermal field, the Geysers, currently produces approximately 800 megawatts of electricity. Pacific Gas and Electric Co., hopes to increase this to 1,568 megawatts by 1984 and estimates the development may be capable of producing 2,000 megawatts. Since 1,000 megawatts is the energy equivalent to 1 million barrels of oil, at 1984 capacity these plants will produce the equivalent of the most optimistic forecasts of petroleum available from the Bodega Basin, an energy equivalent of 530 million barrels in less than a 35-year time frame which is comparable to an offshore development cycle.

The production of geothermal energy does not occur in Sonoma County without significant environmental impacts. We in Sonoma County feel that we are contributing significantly to the Nation's energy needs and feel that any exploitation of marginal energy resources offered by the Bodega Basin imposes environmental costs out of proportion with the potential benefits of the increased energy supply.

The California Energy Resources Conservation and Development Commission predicts that glut conditions and petroleum supplies will continue on the west coast through the 1980's. Oil from northern California may be of such low quality as to be unmarketable. Certainly the extent and quality of the reserve is uncertain as contrasted to the established value of fishing, tourism, agriculture and timber.

The west coast is currently unable to store, refine, and distribute the current oil supply. The logic of further, high-risk oil development which would result in an increased glut and require sale of domestic oil escapes me. I perceive no public benefit in exposing this region to the risk involved in the proposed development to facilitate oil company profiteering by sales of excess oil to foreign refiners.

I have gone through this material in great detail so that you could be exposed to the concerns of the citizens and local government which I represent here today. The complexity and validity of our concerns demand greater attention than we have yet received by representatives of the Federal Government. We hope that this exposure to local concern will encourage you to demand that local and State input be given more weight in this decisionmaking process and that this lease sale be postponed indefinitely.



It is sad that in the face of the energy problems this Nation faces, that we flounder nearly leaderless, and our only response to this critical problem is to find more areas to plunder to support our energy consumption excesses.

Thank you.

Mr. HUGHES. Thank you, Mr. Koenigshofer.

Mr. Farr.

# STATEMENT OF SUPERVISOR SAM FARR, MONTEREY COUNTY, MONTEREY, CALIF.

Mr. FARR. Thank you very much, Chairman Hughes, Congressman Lewis, members of the committee. My name is Sam Farr. I am county supervisor in Monterey County and currently serving as chairman.

I have presented the committee with an outline of the key points. I will not go through that long outline, but just highlight a lot of the points that were made by previous speakers this morning and here today.

Monterey County has been trying to meet the spirit of the new Outer Continental Shelf Lands Act by communicating with government agencies as to the policy and planning decisions that relate to this Outer Continental Shelf management. We applaud this committee's efforts to address these needs because we have found at the local level, and I think I can speak for the northern California counties, that we have not been heard in the Department of the Interior in Washington, D.C.

Last year about this time eight counties, coastal counties in California, made an effort to speak with Secretary Andrus in his office, had about a 2-hour discussion with him, and highlighted all the points you have heard here today and suggested that the OCS lease sale 53 be put on the back burner, delayed, or dropped altogether.

We felt after that meeting with him that he had listened to our points and was very concerned, and a month later he went ahead and announced the lease sale was going forward as scheduled.

This is of great concern to Monterey County because we think we are a county like other coastal counties in California of national significance.

My district is all of Big Sur, which we think is probably one of the most unique coastlines in the world. It takes in the Monterey Peninsula, which is one of the great tourist meccas of the world, and we represent an agricultural industry which is one of the highest ranking in California, producing over half a billion dollars in crops a year.

Many of those crops are coastal dependent. They depend on the air and the water and the soil; crops that cannot be grown anywhere else in the United States.

We feel in Monterey County that the economy of that area is dependent upon agriculture and tourism, and that economy cannot be jeopardized by any kind of offshore oil disasters.

We also believe this committee ought to concern itself in talking about national resources, that we feel that things like artichokes and brussels sprouts and strawberries, and lettuce, which are coast-

al-grown crops, are also of national significance and ought to take that into mind.

The other thing that we are concerned about is tourism. We have on the Monterey Peninsula a tourist industry which is a \$200 million industry a year. That industry is labor intensive. It employs a great number of minorities. It is a rather low wage earning industry. It is people oriented, and half of the population of the Monterey Peninsula is dependent in their economy on tourism.

We also in Monterey County have a unique commercial fishing industry. We have 36 types of fish and shellfish that are commercially fished at the present time, and that industry produces over \$17 million a year.

We think that the other things, mammals that attract tourists to our area, such as the sea otter population, the 25 rare and endangered plant species, the Big Sur coast, and the bird rookeries protected now by the Federal Migratory Bird Conservation Act are some of the assets the Federal Government has helped along with State government in pioneering in California along the coast of Monterey.

We feel that OCS lease sales would jeopardize those economies.

We think that you ought to take into consideration the investments that the Federal Government has already made. We have Los Padres National Forest, which is the largest national forest in California. We have major BLM holdings. The Naval Postgraduate School, which spends a lot of its graduate studies in the marine ecology of the area; the Defense Language Institute, the Weather Station, Fort Ord.

We have been nominated as a marine sanctuary, an estuarian sanctuary.

We have the Army Corps of Engineers working in Moss Landing Harbor, and we have just spent a great deal of Federal money on our water quality planning.

The State has made a great amount of public investment in the Landing Marine Laboratories, the Hopkins Marine Station, Granite Creek Research Laboratory, and has 10 existing and proposed State parks.

We have several marine life refuges and areas of special biological significance.

The point of all of these remarks is that I think all of the counties of California that are dependent on tourism and their economy are concerned that our resources are the basis of our economy and that these resources would be highly jeopardized by any adverse impacts from the lease sale.

We also realize as elected officials that so often we hear in our own boards people saying, "We don't want this project in our own back yard. Do it some place else."

But I would like to point out to the committee that coastal counties in California are not part of the statewide water project, and, as such, when the drought hit the counties several years ago, there was no place to turn and the counties had to survive a very severe drought.

Monterey County cut back its water consumption by 50 percent. The unique thing in doing that is that people learned they could get by with less, and now we are experiencing one of the longest

gaslines in California in the Monterey Peninsula, and probably the first place in California that long gaslines began.

We are surviving that. We have gone to an odd and even system. People are accustomed to having to cut back and make changes in their lifestyle. We think that the rest of the Nation, through energy conservation, could learn to do some of the same things, and could learn to get by with less.

I would like to conclude, so that you can get into questioning, by suggesting that this committee should consider taking the decision-making away from one individual in the Department of the Interior. We feel the Department of the Interior does not seem sympathetic to local governments and coastal counties affected by OCS. We think that the risks outlined by the speakers this morning are not covered by the liabilities that would be incurred because you have not yet completed the studies of this pristine coastline and will not have completed or will not have enough information to know what is there to be jeopardized, and how can we, therefore, check on any adverse impacts to things that are yet unknown?

I would like to also suggest, as other speakers have done, that the committee think about retaining lease sale 53 as a vital national and oil gas reserve in conformance with section 101.9 of the Lands Act amendments.

I would also like to suggest that you think about some of the remarks made here today, not only about the dog that my colleague, Supervisor Koenigshofer, talked about wandering through here, but the children here today, and I think the remarks that really touched me this morning were those of Mrs. Jacob when she talked about the children of tomorrow.

I would like to remind this committee of the remarks of a Spanish philosopher who once said that patriotism is not so much the protection of the land of our forefathers as it is the preservation of the land of our children.

I thank you.

[The information follows:]

#### KEY POINTS TO BE ADDRESSED BY SAM FARR, CHAIRMAN, MONTEREY COUNTY BOARD OF SUPERVISORS

##### I. Introduction

A. I am here representing Monterey in the spirit of the new OCS Lands Act Amendments which emphasize the need to provide local governments the opportunity to participate in policy and planning decisions.

B. We applaud the Committee on its efforts to address local needs and discuss our concerns.

##### II. Monterey's uniqueness: An area of national significance

A. One of the most beautiful, productive and ecologically diverse coastlines making us vitally concerned about threats that OCS development may pose.

B. The purpose of the Act:

1. To balance orderly energy resource development with protection of human, marine and coastal environments.

2. To provide that timing and location of OCS exploration and development \* \* \* shall be based on consideration of \* \* \* existing information on the geographical, geological, and ecological characteristics.

C. In the spirit of this provision we urge the Committee to consider that our economy is entirely resource based.

1. Tourism is our lifeblood, generating over \$300 million annually. It is labor intensive and accounts for half of our employed population.

2. Coastal dependent crops—Salinas Valley is the Nation's Salad Bowl.

3. Fishing based on 36 fish and shellfish species reaps \$17 million annually.
4. We offer the nation a staggering wealth of natural resources.
5. Essentially unspoiled environment due, in part, to its status as an OCS frontier area.

### III. *Federal and State investment*

- A. The need to protect this pristine environment has been reflected in considerable Federal State investment.
- B. Imprudent OCS development could undermine the longstanding efforts to maintain environmental quality in Monterey.

### IV. *Monterey's involvement in the leasing process*

- A. In the spirit of Section 102, subsections 4, 5, and 6 of the Lands Act Amendments we sought access with the best possible information money can buy.
- B. Monterey County has consistently stressed the importance of a full consideration of critical environmental and economic factors.
  1. Negative nomination—major effort by staff and citizen's groups, yet the only tracts deleted were those with low industry interest.
  2. Board of supervisors resolution calling for deletion of all tracts of San Luis Obispo, Monterey and Santa Cruz coast.
  3. AMBAG Technical Advisory Committee letter to Secretary Andrus urging postponement or cancellation of lease sale until completion of all environmental studies.
  4. Major staff burden post Prop. 13—have expended considerable time in review of documents including outline for DEIS and tankering scenarios intended to guide preparation of DEIS.

### V. *Deficiencies in provision of information*

- A. Half of the environmental studies aren't funded.
- B. Results of some funded studies will not be available until after the lease sale.
- C. Studies inadequate to reflect even one seasonal cycle in the marine environment.
- D. Tankering scenarios suggest that Lease Sale 53 oil can be refined on the West Coast, yet tables in the same report clearly indicate that the volumes and composition of all crude dictate tankering along the entire California Coast.
- E. None of the studies adequately address the consequences for our tourist, agricultural, and fisheries industries.

### VI. *Alternatives*

- A. President Carter's recent address to the Association of Cities and Counties provided for working with local governments to solve energy problems.
- B. Rather than giving Monterey such a tremendous burden of environmental and economic risks, brought on by OCS development, we suggest that there are many less costly solutions to the energy crisis to be found at the local level.
- C. We can set an example—Conservation:
  1. Monterey Peninsula cut water consumption 50 percent during the 1977 drought.
  2. Energy bill for county buildings cut \$70,000 by better management.
  - D. A DOE funded study looking at residential, commercial and industrial areas in Baltimore, Minneapolis and Denver demonstrated that the solar contribution to total energy demand could easily meet or exceed the supposed technical limit of 25 percent.
  - E. In comparison, even the most optimistic estimates indicate that Lease Sale 53 oil could supply only 250 days of national need—and that resource cannot be renewed.

### VII. *Conclusions and recommendations*

- A. Our most urgent needs are threefold:
  1. Predictive and baseline information (prescribed in Section 102, subsection 5) that addresses the fact that all Monterey and the rest of the nation stand to lose in catastrophes such as those that hit the Caribbean and South Padre Island. Complete information should be furnished to local government well before a decision to lease tracts of land is made.
  2. Enough time and staff assistance to develop plans management plans for anticipated and unanticipated impacts, as prescribed in Section 102, subsections 4 and 5.
  3. A greater and more influential voice in setting OCS policy as prescribed in Section 101, subsection 6, including the opportunity to pose reasonable alternatives to the lease sale.

B. We urge the Committee to make a commitment to carry out:

1. An OCS Program that meshes with a coherent national energy policy—one that truly recognizes national need, reflecting in President Carter's call for a National Energy Strategy.

2. A cogent schedule that adheres the considerations of refinery capacity, weighing of environmental and national need as prescribed in Section 102, subsection 2, of the OCS Lands Act Amendments.

3. A tract selection process that legitimately weighs the factors prescribed in Section 208, subsection 18 A-H.

C. Our overriding recommendation to the Committee is the retention of Lease Area 53 as a vital national oil and gas reserve in conformance with Section 101, subsection 9, of the Lands Act Amendments.

Mr. HUGHES. Thank you, Mr. Farr.

Mr. Lewis, any questions?

Mr. LEWIS. Mr. Chairman, I would like to follow up, if it is all right with you, on the question that you so ably placed to Supervisor McClendon. Frankly, I would like to have you carry that ball.

Mr. HUGHES. All right. I think all the supervisors heard the question.

That is, I think, one of the biggest complaints that we heard most of yesterday and again today on the part of both local representatives of government units, as well as from the State officials, the State staffers that were there yesterday at the hearings, was that the Secretary is not discharging his obligations under the law.

That is, he is not receiving negative nominations, not receiving the concerns and comments of various States and their local units and giving due credence to them, not responding under the law. I wonder if some of you could perhaps address that issue also, and try to be a little specific, because the law doesn't give the States a veto.

It doesn't say to the States that they will have the last word, and that some jurisdictions, through negative nominations, will be able to exclude almost the entire lease area, and obviously that wasn't the intent of the legislation itself. It was to try to effect a partnership, and it put the onus on the Secretary to make a specific finding by accepting or rejecting local concerns—he had to reduce the findings to writing for committees such as ours, to review those findings, and to determine whether there was a basis to accept or reject the findings. In lease sale No. 53, the Secretary reduced from about 8.2 million acres to 1.3 million acres the land.

Perhaps you can tell us whether some of those areas, specific areas that were singled out, are traffic lanes or whether they are environmentally sensitive areas that you feel the Secretary didn't give due credence to.

And, if it is a lengthy presentation, perhaps what you might want to do is to submit it for the record. We would be very happy to receive for this record the specific comments on those areas that you singled out where the Secretary didn't pay due attention to the concerns.

Mr. FARR. I would like to respond to that quickly.

The process did receive negative nominations. I think you heard earlier every tract received a negative nomination from some place in California. BLM was responsible for receiving those nominations and receiving the input from the oil companies, and they categorized the tracts into a high, moderate and low category.

I think there were a maximum of 27 oil companies that bid and I don't know exactly where they cut off.

Mr. Grant from BLM indicated I think about one-third in each category. Each tract that received 20 nominations or more was classified as a high tract. All of the input from local government had an effect of excluding the moderate and low nominated tracts and left the high tracts for consideration.

I think that there has been some response to specific tracts that were in the high category that have now been excluded, but the number of high interest tracts that have been excluded has been very minimal, and it has seemed to local government as if those were predetermined.

Mr. HUGHES. Perhaps you could develop for this committee, Supervisor Farr, an analysis of that parallel which you think exists between high potential for hydrocarbons and inclusion within that 1.2 million acres for potential lease sale. Rather than put that burden on you today, we would welcome that submission from you and your fellow supervisors, and that would be an immense help to this committee because that has always been one of the most troublesome aspects of the law.

As I indicated earlier in response to a question that might have been suggested by either Mr. Hedlund or Mr. Giacomini that perhaps there should have been additional input by the local governments, many of us on the committee felt we ought to develop a better scheme.

But, we could not really in committee develop a scheme that would give meaningful input and at the same time permit the Secretary to make a decision in the national interest.

Mr. FARR. If I may, just one point on that. I think what we are trying to say is that it is a process of excluding tracts, and then you come to a point of whether the process with the number of tracts left over is really worth it. And, without a national energy policy which we can feel we are a part of, whatever number of tracts you come up with is not satisfactory to the coastal counties of California because we just don't feel that the risk—the risks are high to us, and the gain is very low to the United States.

Mr. HUGHES. Well, that is always a concern. Let me say to you that in the mid-Atlantic sale, for instance, the estimates were very low. As I recall, the entire mid-Atlantic region only had somewhere between 1 and 2 billion barrels of oil potential, high potential. As it has turned out, the areas where we didn't expect to find natural gas, we found significant kinds of natural gas. Areas where we thought there was high potential for oil, we found no oil. I think it points up very vividly that we don't really know until we begin sinking test wells.

Mr. Giacomini—I think it was you that suggested there be a better scheme, and that perhaps local units of government be able to submit to the Secretary their concerns, and I think that I did point out that we found in many instances the Governor represents a composite view of the State, and often some of the counties feel their particular interests are not advanced as aggressively as they should be.

For that reason, it is spelled out in the legislation that you have a right to submit your concerns directly to the Secretary of the

Interior who may receive them. He doesn't have to, but it was our hope that the Secretary would renew any and all negative nominations, whether coming through the Governor, where he must review and receive them, or whether coming directly from a local unit of government.

That avenue of appeal to the Secretary exists for each of the counties.

Mrs. JACOB. If I might, Mr. Chairman, I would like to take advantage of your offer to develop in writing some specific examples of where we as a county of Marin don't feel Interior is following the law, but I would like, by way of summary, to say that my view is, and it is Marin's five supervisors' view, that what is happening is that Interior has been on a course of action and that they just barely follow anything that could approximate the technical letter of the law.

We are getting more response and feedback yesterday and today from this committee of the Congress of the United States than we ever got from any of the facade kinds of hearings that Interior conducted, after dramatic prodding by both the State and local government. There is much more happening here in terms of an exchange and an understanding than ever happened there.

What they are doing, in my view, and I will just use one example—this is very common. I must have 30 letters from Interior like this. In March the Secretary said that in light of the severe environmental concerns advanced by the coastal counties that he might let lease sale 53 slip a few years until accurate base data could be developed. So we wrote him and said that is wonderful; we are glad to hear that.

Then I get a letter back and it says:

In the March 21st article of the Los Angeles Times that you referred to Secretary Andrus is merely quoted as saying there is the possibility that we might slip the schedule. We appreciate your interest in our offshore leasing program and especially for protection of the California coastline.

These are coming off computers.

In other words, I would much rather have a candid response that says no way, and here is why.

In other words, there are relationships happening, but in my view it is phony.

Mr. HUGHES. I might say to you that I have only been in Congress 4½ years, and I know my colleague over here has been in Congress less than that, but I found early on that they don't listen to a lot of us.

Some of our most frustrating moments are dealing with agencies and departments that really are nameless, often faceless; they are not responsive to the public. It is very, very difficult to try to get agencies to carry out what is the intent of the Congress.

We often, because we are unable to agree in committee or in the Congress on specifics, devise legislation that has to be developed administratively and that often creates problems.

But let me say something also in response to something Supervisor Farr said. He would like to remove the Secretary of the Interior from this decisionmaking. I don't know who we would put in his place, and this particular Secretary is so far superior to the Secretary that preceded him. Secretary Andrus has, I think, done a good

job in many respects. I think he has had a very difficult time of it often carrying out his own policies. I am very close to many of the things that I would like to see in place, like prelease exploration. And I know that the oil industry has battled him at every turn in trying to put in place regulations that would permit some prelease exploration, to try to minimize some of the impacts we are talking about.

So in defense of Secretary Andrus, let me say that I think that he is well-intentioned. He often is not privy to some of the letters that go out to you, as you well know, and I think he is extremely responsive to this committee.

One of the questions that has been raised, both yesterday and today, was what can this committee do with perhaps violations of the intent of the Congress. I can only say to you that the chairman of this committee, Chairman Murphy from New York, is chairman of the Merchant Marine and Fisheries Committee and a very influential Member of the Congress. This committee has already, through oversight hearings, changed policies where they were not carrying out the intent of the Congress.

So we can do a great deal through this hearing process.

You often hear it said that people are not heard, but we are here today and we are hearing, and we listen very well. Sometimes it doesn't appear as if your interests are being heard, but there often is a conflict between the national interest, as you well know, and the local interests.

In every area of this country from Alaska, where we visited just a few years ago, to the Georges Bank and other regions, we have very sensitive areas and the people are very concerned about these precious treasures.

It is our hope that out of these hearings will come the kind of balances we are looking for. I think that is what you are asking for. You are not asking that the Interior Department accept totally what you suggest, but that you be listened to, that you have input, and I think that that is a process that we want to develop, too.

Mrs. JACOB. First, all the things you say about this committee is why we are so damned excited you are here, because you have had incredible results with Interior.

If I might, and some of the supervisors were not there yesterday, but to me the attitude of Interior was best summarized yesterday when the constant point kept being made that local government and local input wasn't really being listened to, and the woman from Interior said, "How can we do that on lease sale 53? There are thousands of affected local governments."

Do you know what there are? Eight counties. So if the attitude is that we are a bunch of little, dumb gnats buzzing around, a lot of trouble and there are thousands of us when the fact is there are eight—and interestingly enough, you don't see boards of supervisors line up like this on an issue, 5 to 0, when they split on every single issue.

Mr. LEWIS. Mr. Chairman.

Mr. HUGHES. Mr. Lewis.

Mr. LEWIS. Supervisor Jacob has highlighted Interior's tendency to think it is impossible, without even asking what the impossibility is. But nonetheless, as we develop the process for attempting to



evaluate domestic needs by year, a procedure was set in motion to try to pinpoint questions such as needs and potential by area, such as environmental impact, such as eventual production capacity, as all of those things relate to production goals.

That outline was published in March and it was sent to the coastal States with specific request for their response, their evaluation of those production goals, and the elements that are part of it. Only one State of all the coastal States did not respond, and I would guess you couldn't guess what State that might be. The State of California did not respond.

I have no idea whether our bureaucracies asked you what you thought about those production goals, but I guess it becomes one bottom line point and that is, we need action coming from the local level, communicating with us.

I can tell you in the short time I have been in the Congress, I have seen this oversight committee, whose job it is to say are the folks out there doing what we directed them to do by our legislation—this committee is willing to take on Interior and others who are not responsive. That in part is why we are here.

But this goes way beyond just you members of the board of supervisors. The people behind you are the ones that count because they cause you to react and me to react, and John Burton, Don Clausen to react.

I sometimes think our function is to put the needle in the side of the bureaucracy and watch it quiver because then we know it is alive.

Mr. HEDLUND. Mr. Hughes, may I respond to your question?

I want to make two particular observations and one general remark.

First, with regard to tracts 001 through 029, which are immediately west of Eureka, our county negatively nominated them. They were also negatively nominated by various environmental groups.

It was a unanimous vote of the board of supervisors prior to the time I was on the board.

In 1963 the area just west of Eureka was withheld from the previous offshore Federal sale because of the shipping lanes into Eureka, according to Hoskins and Griffiths in an "AAPG," I don't know what that group is, memoir on future petroleum provinces of the United States, their geology potential.

This time around, however, they are still in the sale. They are right in our shipping lanes. That would seem to be the kind of a problem that we would expect response on. The county received no response on how it is safe to run ships—we have fog all summer.

The industry says that under the new Port and Tanker Safety Act these kinds of installations are widely scattered and there is no reason to believe there will be a significant problem.

Well, the new Port and Safety Act, as I understand it, allows ships to go outside of shipping lanes. Nevertheless, they still have to come in through them when they are going into a harbor.

So I think that was a real problem and it should have been answered.

The second particular response, in January we heard the Geologic Survey was going to temporarily suspend portions of 30 CFR

status 250.34, regulations controlling exploration and development and production plans for the Outer Continental Shelf.

I think that was to allow exploratory drilling prior to EIs being filed. That was the rumor we heard. Whether or not it was true, our board directed a letter to Mr. Adlinski, Acting Director of the Interior, on January 23rd. We still have not received an answer of any sort.

Now, my general remark is this: After Carter came out of Camp David and the announcement was made by Mr. Duncan that they were going to accelerate the 5-year lease sale program, as if, the EIs process having been established and presented, all the problems had been met, we could just go ahead and accelerate things, raised a question for me, a general concern, which I like to call the vanishing decision point.

NEPA and your legislation established the process through which people were supposed to go to make decisions, but gradually the administrative interpretation of those by the bureaucracy has operated in such a way that those procedures should get reinterpreted until the decision gets made—it is hard to perceive exactly where the decision is being made. It is just made.

I think I would use the particular example of these parcels, 001 through 029 as an example of that. They are approved for exploration or for consideration for exploration without our having received a response on our negative declaration.

Mr. HUGHES. We thank you for that. What we invite you to do is submit also additional negative nominations with site specific problems, and then perhaps we can examine those in the light of the second findings and determine whether the law is being complied with.

Mr. KOENIGSHOFER. Mr. Hughes—I would offer, and I think that my colleagues will agree to do this—we will correlate the positive nominations with the tracts that are still being considered, and I think you will find that there is almost an unbelievable correspondence between the two. And I think further that one good example of this complaint is the area right off Tomales Bay and Bodega Bay. The area has tremendous problems, environmentally, and in conflict with the fishing industry. Yet it remains in the process.

I think one point that I have felt has been said over and over again by constituents that I deal with daily is that we have had I think one meeting with BLM in Santa Rosa, and it lasted for a couple of hours, we got not a lot of response. And yet there was still maintained in the process this very sensitive area. It appears to us that there were a large number of tracts originally proposed, that the ones that the industry really wanted to deal with are still in there, and that the only ones we had an impact on are the ones that really did not make a difference to them anyway. This makes us feel like we are put through the paces sometimes, even to the extent of going back to Washington, representatives from each of these counties involved, to talk directly with the Secretary. And yet what we accomplished is invisible. This causes a great deal of concern—and in a time when there is as much criticism and lack of confidence in government as there is, it is particularly disconcerting to experience that.

The other point that makes me a little leery, personally, is I am certain on a day-to-day basis that industry has a significantly greater presence in Washington, D.C., than these eight California counties that we are talking about. This opportunity is really the only opportunity, the only exchange that I have participated in that I feel has been productive with anyone from the Federal Government that I have perceived to be representative. I thank you for that. I hope that somehow the bureaucracy will result in more of an impact for our point of view. I think that is important. Because California is unique, I think, in terms of its situation with respect to the rest of the country.

We are talking about a series of counties that span a large, large area of the North American Continent, and that include a significant number of people. In fact, just for the purpose of putting things in context, one county in California, Los Angeles, has 3 million more people than the President's home State. So when we talk about a county in California, we are talking about a lot of people. We are not talking about some small unit of local government tucked away out in the boonies somewhere. We represent hundreds of thousands of people. And we like to feel we have an impact.

Mr. HUGHES. Thank you.

I want to again thank the panel. We will be happy to receive any additional testimony you want to receive on any of the issues that you testified to. But we hear your concerns, and we share them. And again, thank you.

Mr. GIACOMINI. We are very grateful. Thank you.

Mr. LEWIS. Mr. Chairman, Supervisor Giacomini, I just wanted to let the people know at 7:30 this morning you mentioned the ride, but you did not mention the fact that you were not just our host, but served as the M.C. on the bus trip and pointed out all kinds of things. It is obvious you know your territory. Thank you.

Mr. HUGHES. Our next and final witness is Mr. Zeke Grader, who is the general manager, counsel, for the Pacific Coast Federation of Fishermen's Associations. Mr. Grader.

#### STATEMENT OF PAUL WOOD, SECRETARY-TREASURER, PACIFIC COAST FEDERATION OF FISHERMEN'S ASSOCIATIONS

Mr. WOOD. Mr. Chairman, it was my impression that yesterday Zeke Grader cleared with you all the possibility of my testifying in his place. He was called to Sacramento yesterday on some urgent business.

Mr. HUGHES. Would you identify yourself.

Mr. WOOD. I will just be highlighting the testimony.

I am Paul Wood. I am a commercial fisherman from Bodega Bay. I also serve as secretary-treasurer for the Pacific Coast Federation of Fishermen's Associations, of which Zeke Grader is our general manager.

We are grateful that we have the chance also to testify before you. Our federation represents 15 California commercial fisherman's associations from Crescent City to San Diego. Through our member organizations, we represent many of the salmon, rock and dungeness crab, pink shrimp, sablefish, swordfish, herring, rockfish, sea bass, and abalone fishermen who will be dramatically

affected by any future offshore oil development along the northern and central California coast. We hope that you enjoyed your salmon for lunch; that was undoubtedly caught by one of our members.

Mr. HUGHES. Absolutely delightful.

Mr. WOOD. I will just summarize what we had intended to say. We have heard many of the points raised that we would have liked to have raised with our testimony. We heard that repeated today. I would like to just underscore several of them.

It has been most gratifying to sit here as a member of the fishing industry hearing so many people repeatedly indicate their concern for the health and survival of our industry. Possibly I can be a little bit more specific about some of the problems we envision.

To the detriment of California's fishery and environment resources, the Interior Department designated northern and central California as one lease area, even though there are five separate sedimentary basins along 700 miles of coastline in this region. A basin-by-basin examination of this region would have provided BLM with a more thorough evaluation of the risks involved with OCS development in California, while allowing for realistic comparisons of OCS regions. Unfortunately, this type of approach was not employed, and as a result, the local environmental, social, and economic factors have been neglected, whereas petroleum benefits were emphasized. We feel there are a great many unanswered questions. We have heard them alluded to all day.

We would like to see more study done and more serious consideration of the real conflict that will result between the traditional use of OCS for harvesting fish and the proposed use of the OCS for oil development.

To glibly say it is a big ocean and we can live together avoids the point that what are the high interest areas for us are also high interest areas for possible petroleum development.

The areas proposed in the Bodega Basin are not adjacent to fishing grounds. They are right smack dab on top of them. We have had problems before, even when some exploration has been done.

I appreciated Senator Behr's testimony this morning. I would take issue with one minor point that I think which in large part holds true. He said if there is exploration and we find nothing, then we have no problem. We find problems with some of the exploration that goes on. These may be minor problems in comparison with the long-term effects of actual drilling and operating operations. Whenever there is any seismic testing going on, all fishing activity is greatly in jeopardy. The fishing for salmon in particular at that time is impossible. Boats shudder at 5 miles' distance from any of these seismic operations. And this is a minor inconvenience. Nonetheless it is one indication of a conflict.

We have had some experience with our members running into what are called Christmas trees. Exploratory drilling is sometimes done, and when these wells are capped off by law they should be capped off 6 feet beneath the surface of the ocean floor. Unfortunately this does not happen, and it takes a trawler to find out. These Christmas trees are plumbing apparatus to cap off exploratory wells. They usually extend 6 feet above the surface of the ocean, just in perfect position to snag trawl nets as they go by.

We anticipate were there to be any wells, platforms out in our part of the ocean that we like to fish in, that these would cause significant hazards, as simple obstructions, hazards to navigation, if you will.

As we just heard testimony from a supervisor from Humboldt County, the eight tracts in the Bodega basin is where we encounter most of the shipping traffic that we have to dodge daily.

We have no mention in the studies that we are aware of on this particular lease sale of any indications of sensitivity to the potential changes in migratory patterns for salmon and other species. This represents another point of conflict for using the same fishing and oil well drilling grounds.

The grounds that are in the Bodega Basin are adjacent to some very, very rich nursery areas for rockfish. The disruption of nursery areas means the disruption of fishing.

Conflicts were alluded to by our supervisor Koenigshofer in terms of conflicts in port facilities. It is laughable to think of port facilities being available in Bodega Bay without a major reorientation of the entire community and of the limited real estate that borders on the waterfront. This should not be minimized because we realize that crew boats and supply boats need to have some point of access that is relatively close to the proposed sites.

We certainly would not want any conflict of that sort in our harbor and none of the harbors up and down the coast.

Transportation of the OCS oil becomes another point of conflict. We have pipelines or tankers as alternatives. We have heard that tankers would be the preferred option most likely off our coast. As a fisherman who hates being out in the shipping lanes in the fog, we do not need any more traffic out there. It is dangerous enough as it is. This again may be a minimal conflict, until you get run over by one of them.

Pipelines provide a conflict where like the Christmas trees trawl gear is easily snagged on pipelines, or has the potential to snag on pipelines and result in costly gear loss.

There is a fisherman's contingency fund to mitigate such losses. But as to our membership's knowledge and experience, this contingency fund has not worked effectively, and it has wound up mostly in the frustration of fishermen having any losses mitigated through it.

Perhaps the one thing that I can try to impress upon you, however, which is in the written testimony that you will have before you, is the damage and the conflict because of the economic, cultural, and social impacts on fishing and fishermen from the OCS oil and gas development.

Our industry in the State contributes to the California economy roughly \$1¼ billion annually. This is in excess of the landed value of the fish. But by the time that it is handled in California, it has added that much to the economy. And with the increased investment in fisheries, and fisheries enhancement programs which are going ahead in this State, we can expect that value to rise.

We are proud of our fishing industry and the fishing industry's tangential connection with tourism. We have a lot of people who like to come to our towns and see if our boats smell the way they

are supposed to, like to look at them. And we are proud in that way to contribute to tourism.

We also have the cultural and social impacts. Like the economic impact of the fishing industry, which has been totally ignored in terms of any impact studies that have been done in connection with this lease sale, we have seen nothing that indicates any sensitivity whatsoever to the cultural and social impacts in our fishing communities.

Fishermen and their activities form an integral part of coastal communities. Many fishermen support and participate in community activities. And fishing in the traditional sense is a family operation. Generally the art of commercial fishing is passed from generation to generation within a particular family. The central and northern California fishing industry is unique in that it represents an example of the last independently owned and operated businesses still existing in America. Thus the loss of a fisherman's livelihood and all that it signifies cannot be replaced with money or another type of employment. We realize the difficulty of quantifying the cultural and social value of commercial fishing. But this does not mean that it should be entirely ignored by BLM.

Finally, the last impact for which we have heard repeated concern all day is that of the environmental impact. We would hope that before any further work or before any further activity goes on, that we would see studies indicating the damage of oil to marine organisms in their larval stages of development conducted or followed through on. In addition, one of the big questions which is nowhere addressed but for which we have great concern is that studies indicate what is the contribution in terms of heavy metals from drilling muds. The presence of certain heavy metals in fisheries products just sends quivers up the spines of most fishermen. I would assume that being from the east coast, sir, you are familiar with mercury in swordfish. And we would like to see a great amount of seriousness attached to studying what is the potential for introducing heavy metals into the marine environment that our fish would have to grow in. This could ruin our economy. This could ruin our industry.

To summarize, we believe that the Interior Department and the Bureau of Land Management have not adequately studied the impact of OCS oil and gas development upon northern and central California's commercial fisheries and commercial fishing industry. When considering the amount of governmental funds spent to determine the quantity and quality of OCS petroleum reserves, it only seems fair that other industries utilizing the OCS be equally evaluated.

If the 5-year leasing program had been prepared by the Interior Department after considering all of the OCS-mandated factors, many of the concerns being expressed by organizations and citizens could have been avoided. A basin-by-basin evaluation of the northern and central California lease area would have demonstrated the potential for severe environmental, economic, and social damage. This type of approach would have allowed for the deletion of those areas with low petroleum reserves and high environmental sensitivity.

We strongly suggest that more studies specific to each basin in lease sale #53 be conducted regarding OCS use conflicts, economic impact upon commercial fishermen, and environmental impacts upon commercial fisheries from OCS oil and gas development. With this information, the Secretary of the Interior would then be capable of making an equitable decision as to the extent of leasing necessary to balance the Nation's oil and gas needs with other valuable uses of the OCS and environmental risks.

Thank you.

[The information follows:]

TESTIMONY OF WILLIAM F. "ZEKE" GRADER, JR.

Mr. Chairman, members of the committee, my name is Zeke Grader, I am the General Manager and Counsel for the Pacific Coast Federation of Fishermen's Associations. I am pleased to have the opportunity to testify before your Committee here today.

The Pacific Coast Federation of Fishermen's Associations represents 15 California commercial fishermen's associations from Crescent City to San Diego. Through our member organizations, we represent many of the salmon, rock and dungeness crab, pink shrimp, sablefish, swordfish, herring, rockfish, sea bass, and abalone fishermen who will be dramatically affected by any future offshore oil development along the northern and central California coast.

From our review of the Interior Department's five-year OCS oil and gas leasing program and the Bureau of Land Management's (BLM) activities regarding lease sale #53, it is apparent that the California fishing industry is not being given adequate consideration as is mandated by the OCS Lands Act of 1978. Therefore, we would like to take this opportunity to inform you of some problems existing with the five-year lease program and lease sale #53.

The five-year oil and gas leasing program established by the Interior Department was prepared without consideration of all the factors mandated by the OCS Land Act of 1978. Specifically, the mandated factors overlooked by Interior are: the equitable sharing of oil and gas development benefits and environmental risks among all OCS areas; other uses of OCS; the relative environmental sensitivity and marine productivity of different areas; and the environment and predictive information on the areas. By ignoring the intent of the OCS Act during preparation of the program, many problems have arisen with the implementation of the lease-sale process in California. To the detriment of California's fishery and environment resources, the Interior Department designated northern and central California as one lease area, even though there are five separate sedimentary basins along 700 miles of coastline in this region. A basin-by-basin examination of this region would have provided BLM with a more thorough evaluation of the risks involved with OCS development in California, while allowing for realistic comparisons of OCS regions. Unfortunately, this type of approach was not employed, and as a result, the local environmental, social, and economic factors have been neglected, whereas petroleum benefits were emphasized.

The other major issues confronting California fishermen specifically regarding lease sale #53 are:

1. The conflict between the traditional use of the OCS for harvesting fish and future oil development;
2. The economic, cultural and social impacts of OCS development upon fishermen and their communities; and
3. The environmental impact on commercial fisheries from OCS development.

We would now like to individually discuss these issues.

1. THE CONFLICT BETWEEN THE TRADITIONAL USE OF OCS FOR HARVESTING FISH AND FUTURE OCS OIL DEVELOPMENT

*A. Loss of area to fishing*

The loss of fishing area resulting from OCS oil development can be significant when considering platforms, pipelines, tanker traffic and pollution. Structures, such as platforms and pipelines, not only obstruct fishing, but pose a hazard to fishermen. The development activities may cause changes in the marine ecosystem which could affect fish migration and behavior. Oil pollution may not directly destroy marine life, but the fish would have high concentrations of pollutants, making it

inedible. Furthermore, certain offshore areas may be particularly important to fisheries because they are nursery or spawning grounds for fish. The attempt should be made to identify these areas so that they could be excluded from oil development.

### *B. Conflicting use of harbor facilities*

Currently in central and northern California commercial fishermen are experiencing a shortage of harbor facilities in most ports. In many areas, the expansion of facilities to accommodate ships necessary for oil development would be impossible. California's estuaries and coastal marshes have already been significantly impacted by development. The estuaries still existing are primarily located in northern and central California, and are important to fisheries, bird life, and to maintaining the natural character of an area. Other factors to consider are the increased hazards to all users of harbors and the increase of pollution from boat operation and onshore oil-related facilities.

The California Coastal Act of 1976 mandates the state to protect and enhance commercial and recreational boating facilities. Additionally, the Act calls for orderly development of the coastline while protecting pristine areas, and states the desire to congregate industrial development in areas where it already exists. Obviously, a serious conflict will arise if commercial fishing, and its associated industries, are displaced or impacted by new oil-related facilities, especially in non-industrial ports, such as those in northern California. No studies of the possible harbor-use conflicts arising from OCS development have been prepared by BLM specifically for northern and central California.

We believe this is a gross deficiency in the planning process since both of these regions have retained their natural character which is to be preserved by the Coastal Act.

### *C. Transportation of OCS oil*

Many of the conflicts presently occurring between fishermen and OCS oil development emanate from the transportation of OCS oil. The two principal modes for transporting oil are by tanker and pipeline. Both can pose a severe hazard to fishermen and interfere with fishing activities. The most common problem encountered by fishermen is the ultimate loss of fishing gear resulting from tangling with pipelines or oil development debris.

The Fishermen's Contingency Fund was established to reimburse fishermen for their losses, but apparently the process of compensation is very slow. In many regions, fishermen have become frustrated with the process, and we believe the mechanism should be improved prior to further OCS development.

The increased number of tankers and OCS-related ships is also seen as a serious impediment to fishing activities. The navigational problems originating from all aspects OCS development have not been addressed by the Interior Department. The Interior Department must establish sealanes along the central and northern California coastline to reduce the risks to other users of the ocean. Fishermen must be an active participant in the decision process as to placement of sealanes. Additionally, the Interior Department must consider navigational hazards when developing contracts for OCS oil and gas leasing, and specifically stop leasing tracts for oil development within designated sealanes.

Furthermore, we strongly recommend that:

1. Stronger regulations be implemented governing the operation and maintenance of tankers. Also, the qualifications for tanker operators and crew must be drastically improved. Enforcement efforts must be accelerated if present and future regulations are to be effective in minimizing oil spills and other catastrophes;
2. Methods for tracing oil must be developed if polluters are to be held accountable; and
3. New methods for laying pipeline on the seabed must be developed to prevent fishing gear loss.

## 2. ECONOMIC, CULTURAL AND SOCIAL IMPACTS ON FISHERMEN FROM OCS OIL AND GAS DEVELOPMENT

### *A. Economic impact*

The commercial fishing industry and its associated businesses significantly contribute to both state and national economies. The California Department of Fish & Game's most recent statistics (1975) calculated the dollar value of fish landings in central and northern California as \$26,067,864. According to the State Resources Agency, the current annual value of California commercial fishing industry is \$1.25 billion, and with increased investment in fisheries enhancement this value is sure to rise.



California ranks second in the nation in the value of its commercial fishing industry. Some of the high-quality fish products from California are exported to other nations helping to reduce our deficit of payments.

In most small communities in northern and central California, commercial fishing is a valuable aspect of the local economy. The various ports and towns are homes for not only California commercial fishermen, but for fishermen from Oregon and Washington who also stimulate the local economy. Moreover, the aesthetic attraction of the fishing vessels and their operations contribute immensely to another extremely important coastal industry—tourism.

The economic implications of OCS oil and gas development for fishermen and their local communities will be disastrous unless strict regulations are established to protect the traditional coastal industries. Economic impacts of this nature are ultimately felt on the state and national levels also. Therefore, the BLM must thoroughly examine and quantify the economic impacts upon the fishing industry from OCS development. This information should then be utilized to avoid placing unnecessary economic burdens upon the fishing industry which would eventually affect the nation's food supply. To our knowledge, no economic studies of the central and northern California commercial fishing industry have been prepared for use in the Environmental Impact Statement (EIS). This type of negligence is inexcusable and should be immediately corrected.

### *B. Cultural and social impacts*

Fishermen and their activities form an integral part of coastal communities. Many fishermen support and participate in community activities. Fishing, in the traditional sense, in a family operation. Generally, the art of commercial fishing is passed from generation to generation within a particular family. The central and northern California fishing industry is unique in that it represents an example of the last independently owned and operates businesses still existing in America. Thus, the loss of a fisherman's livelihood, and all that it signifies, can not be replaced with money, or another type of employment. We realize the difficulty of quantifying the cultural and social value of commercial fishing, but this does not mean that it should be entirely ignored by BLM.

### 3. ENVIRONMENTAL IMPACT OF OCS OIL AND GAS DEVELOPMENT

I believe all of us here realize the obvious environmental impacts of OCS oil and gas development. More important, though, are the underlying impacts associated with oil development in general, and specifically oil spills and pollution. Certain aspects of the environment are being studied by BLM, but more information must be generated concerning cumulative impacts, oil toxicity to commercial fish species, and drilling mud and heavy metal toxicity to fish (including other studies previously mentioned in testimony). BLM should also review current studies relating genetic damage to marine larval stages from oil. The long-term genetic damage to fish populations from oil may be far more severe than the immediate and deadly results of an oil spill. Many studies that are necessary are either not being conducted or may not be completed in time to be included in the EIS, we believe that the adequacy of the EIS will be questionable. Additionally, the Interior Department must conduct monitoring of impacts and follow-up studies after development begins.

By implementing the recommendations stated earlier in the testimony regarding transportation of oil, the probability of an oil spill occurring can be reduced. Prevention of spills and pollution must be emphasized because obviously no effective methods for containing an oil spill exist. The Interior Department must take all measures of preventing oil disasters, including the option of prohibiting oil development where the environmental amenities, including commercial fisheries, are particularly sensitive and valuable.

### SUMMARY AND CONCLUSION

To summarize, we believe that the Interior Department and the Bureau of Land Management have not adequately studied the impact of OCS oil and gas development upon northern and central California's commercial fisheries and commercial fishing industry. When considering the amount of governmental funds spent to determine the quantity and quality of OCS petroleum reserves, it only seems fair that other industries utilizing the OCS be equally evaluated.

If the five-year leasing program had been prepared by the Interior Department after considering *all* of the OCS mandated factors, many of the concerns being expressed by organizations and citizens could have been avoided. A basin-by-basin evaluation of the northern and central California lease sale area would have demon-

strated the potential for severe environmental, economic and social damage. This type of approach would have allowed for the deletion of those areas with low petroleum reserves and high environmental sensitivity.

We strongly suggest that more studies specific to each basin in lease sale #53 be conducted regarding OCS use conflicts, economic impact upon commercial fishermen and environmental impacts upon commercial fisheries from OCS oil and gas development. With this information, the Secretary of Interior would then be capable of making an equitable decision as to the extent of leasing necessary to balance the nation's oil and gas needs with other valuable uses of the OCS and environmental risks.

Mr. HUGHES. Thank you, Mr. Wood. Mr. Lewis.

Mr. LEWIS. Thank you, Mr. Chairman.

Mr. Wood, your testimony stimulates all kinds of questions. I am not sure that we can really get to too many of the answers today, but I would like to raise two or three areas for questioning. Maybe we will even have our staff send you and your people some material that we have been working on to get your reactions as well.

Generally the data and information that I have been receiving as a member of this committee would indicate that around the world, where there is this kind of development, at least the data we have received tells us that because of those rigs and otherwise there is an increase in the potential yield. I am frankly not sold on that as a fact. But in terms of the material that we have received, and the information we get from Interior and otherwise, that is the line that comes forth.

I would be very intrigued for the record or otherwise to have any resource or studies or data that you might refer us to that would talk about the other side of that story.

Mr. WOOD. I would refer you to the Chevron commercial, with the happy shrimp fisherman in the Gulf States, where he is loving to fish around that beautiful platform. Because that is the image that I think is given off, very professionally, too.

When I mentioned the problem of heavy metals, there are some species that we fish for that take a great deal—there is a great difference in the amount of time that a shrimp takes to mature and, say, a sablefish, rock cod, some tuna, swordfish. These longer-lived fish have to survive in an area around the rig or pass through the area of the rig much more often than, say, a shortlived fish that is part of the harvest. I do not believe there is adequate information that indicates that staying there for long periods of time is a good idea for that fish.

Perhaps in the shorterlived ones—I remember the shrimp fisherman, for example, on the Chevron commercial. And some indications that even in the Channel Islands there is some increase in reef fishing, as the platforms provide artificial reefs. I don't know that there are studies indicating the fish caught in that area, the longerlived fish, some of the rockfish in the Channel Islands, are that good to eat. I hate to introduce that as a subject, but I guess I just did.

Mr. LEWIS. In Congressman Hughes' district, I guess, Georges Bank area, I understand that land-based facilities have been a problem because local fishing professionals cannot compete with the oil companies for land-based facilities. It seems to me that could be a very real problem. Here I do not know if you have had a chance to evaluate that. But that would be helpful material for the

record as well, what you might anticipate in that connection. I don't know how you would do it. But I would be interested in some reaction.

I guess that is about it, Mr. Chairman.

Mr. HUGHES. Thank you. Well, thank you very much, Mr. Wood. I just might say to you that the fishermen's compensation gear fund has just been implemented, so there has been very little experience with it really to date. I have served on this committee for the 4½ years I have been in the Congress. In our trips to the North Sea area, for instance, there were fishing villages that expected tremendous impact. It did not have the impact that was contemplated. What they found was most of their problems were created because trash barrels and what have you were thrown overboard, and damaged the gear. Also much of the complaint was directed to the loss of vessels to the industry. It wasn't economically productive for them to continue fishing. So we heard some complaints in that respect.

As you know, we have been developing oil offshore in the gulf for years, and it has not impacted the fish in that area. That was one of my main concerns, because I have a large fishing industry out of Cape May, which was once the pride of the fleet in New Jersey. And I have a lot of oystering, a shellclam industry, a lot of draggers go out of my district. So we were concerned about some of the concerns you have expressed today also.

Finally, insofar as heavy metals, I don't know if we have detected any concerns along that line, but we do appreciate your testimony. It is certainly something we ought to keep in mind as we examine the results in other areas of the country where OCS development is now taking place.

Mr. WOOD. If I can just briefly respond, and I promise I will leave. I believe that our concerns are that we have not been satisfied that enough serious questions and answers have been exchanged in this whole thing. We are concerned, like the rest of the witnesses today, that things have been speeded up too much. We want to know. We don't proclaim that this will mean the end to our fishing industry. But we want to be a little bit more sure. If we have to take a shot in the dark, let's open the blinds a little further.

Mr. HUGHES. You want the assurance they have looked at it a lot more closely?

Mr. WOOD. Yes, sir.

Mr. HUGHES. I think that is a legitimate concern. Again, we thank you very much for your testimony.

Mr. WOOD. Thank you.

Mr. HUGHES. I would like to take this opportunity to thank Mr. Garm Bill, who operated the microphone today. I noticed also that some of the ladies from the Marin County Conservation League have come into the room. Although I thanked them publicly earlier, let me just again repeat, we thank you for hosting the luncheon today. It was delightful. We have had a most enjoyable visit. We are deeply grateful.

I also want to echo the sentiments of my colleague from California, Mr. Lewis, in thanking Mr. Giacomini. Again, finally, to the audience: You have been a most patient audience. We thank you

for that. I know that at times you were straining to hear the testimony. We know that you have been extra patient and extra attentive. And for that we are deeply appreciative. Again, thank you for having us to this lovely part of California.

This meeting stands adjourned.

[The following material was supplied for inclusion in the printed record:]

# PREPARED STATEMENT OF STATE SENATOR BARRY KEENE

## THE SIZE AND TIMING OF LEASE SALE NO. 53

Mr. Chairman and members of the committee, I am grateful for this opportunity to present testimony on Lease Sale No. 53 which proposes to develop oil and gas resources off the Northern California coast. My constituents are directly affected by this lease sale. Five of the six counties I represent (Marin, Sonoma, Mendocino, Humboldt, and Del Norte) are coastal counties accounting for 400 miles or approximately one-third of California's 1100-mile coastline.

There are serious concerns about the size and timing of Lease Sale No. 53.

In his energy message of April 5, 1979, President Carter stated that, "Passage of amendments to the OCS Lands Act last year provides the tools to pursue an even more ambitious offshore effort."

From every point of view the OCS Lands Act Amendments of 1978 presented the most significant step forward in ensuring safe development of the outer continental shelf (OCS) since the first OCS Act was passed in 1953. The 1978 amendments were developed carefully over a period of years and, for the first time, require that national energy needs, state coastal management plans and eight various economic and environmental factors all be taken into account when considering offshore leasing.

However, the comments I have received from my constituents, as well as my own observations of how the leasing program is being conducted, lead me to conclude that Lease Sale No. 53, covering 700 miles of Northern California's coastline, is not being implemented in the manner contemplated by passage of the 1978 OCS Amendments.

The 1978 law required that eight factors be taken into account:

1. existing geological and ecological characteristics of the various OCS regions;
2. an equitable sharing of developmental benefits and environmental risks;
3. the location of regions with respect to regional and national energy markets;
4. the location of the regions with respect to other uses of the seabed and sea, such as fisheries, navigation, or deepwater ports;
5. oil industry interest in developing certain areas of the OCS;
6. law, goals and policies of the affected States which have been specifically identified by the States to the Secretary of the Interior;
7. the relative environmental sensitivity and marine productivity of the regions;
8. environmental and predictive information for the various OCS regions.

The sheer magnitude of the area treated in Lease Sale No. 53 makes it virtually impossible to consider the above factors fully and fairly.

Last year the Interior Department designated 1.3 million acres in 143 areas as potential sites for drilling within Lease Sale No. 53. These areas extend 700 miles from Point Conception to the Oregon border. They are located in five distinct geologic basins.

I do not believe it is in the best interest of the potentially impacted counties, the State of California or our national energy future to consider so large and diverse an area as one entity for purposes of this lease sale. For example, the San Mateo County coast and the Mendocino County coast are two of the five areas off which tracts are proposed for lease. Yet, they bear little, if any, resemblance to each other in economic, environmental or demographic terms. An argument might be made for including them in the same lease sale if tracts off their respective shores were part of the same geologic basin. However, this is not the case.

The scope of Lease Sale No. 53 should be decreased to give more careful consideration to each of the five geologic basins. The resource potential of the San Luis Obispo County OCS has little relationship to the resource potential of the Humboldt County OCS. They are 600 miles apart and deserve to be considered separately so that their role in meeting national energy needs, their effect on coastal management plans, and the eight economic and environmental factors in the 1978 law truly can be considered as that law intended.

Because of the valuable economic and environmental resources at stake and the unknown potential impact of drilling off the Northern California OCS, the cost-benefit ratio of Lease Sale No. 53 as it is presently constituted is questionable.

Commercial fishermen testifying here today will describe the substantial value of the Northern California fishery resource. I understand the Department of the Interior estimates it to be about 722,000 lbs. valued at over \$228 million. What would be the effect of day-to-day offshore drilling operations on this resource and the many people who depend on it for their livelihood? How would the fishery resource be affected by an oil spill or a blowout?

The same questions about the impact of drilling operations and the effect of a spill or blowout must be asked and answered with regard to other North Coast resources and economic activities, including the impact on our tidelands and wetlands and the fish, waterfowl and other wildlife they sustain, and the impact on our tourist and recreational fishing industry.

State and local governmental entities advise me that these critical questions are not receiving adequate consideration by the Department of the Interior. The state Coastal Commission believes studies that could provide some answers to these questions are not available, although the Interior Department lists them as "completed" in its proposed program for Lease Sale No. 53. The State Lands Commission has expressed concern that necessary environmental baseline data will not be ready in sufficient detail prior to federal leasing decisions in Northern California. This is a complaint I have also heard from many of my constituents.

Before a decision is made to lease any areas off the Northern California coast, a number of other issues must be considered. The conclusions drawn should be evaluated further in light of estimations that the resource potential of the Northern California OCS is not expected to be great.

The issues we can identify readily are as follows:

1. Oil companies now tell us that if oil is found in the area, refineries would not be built on the North Coast. Instead, oil would be transported south by pipeline or tanker. What is the likelihood of spills in treacherous North Coast waters where severe storms are known to occur with little or no warning?

2. The severity of storms, the regularity of rough seas, and the potential for seismic activity on the North Coast OCS do increase the chances for oil spills. How can risk be minimized when straw still appears to be the best technology available for spill cleanups in rough seas?

3. There is a lack of onshore commercial fishing facilities at the present time on the North Coast. The Spud Point Marina proposed for construction at Bodega Bay in Sonoma County is in the process of receiving approval from various government agencies. Construction of the Woodley Island Marina in Humboldt County has just begun. Obtaining these facilities—which will probably be filled to capacity immediately upon completion—has been and continues to be an extremely difficult process. One of the reasons is that North Coast land is not easily acquired or developed. How will the onshore impact of offshore drilling be handled? Where will land be obtained for needed onshore facilities associated with offshore drilling?

The U.S. Geological Survey ranks the resource potential of the Northern California OCS as sixteenth out of the 22 areas proposed for lease. Although the resource potential estimates do involve a great deal of guesswork, the U.S.G.S. estimate does not indicate a sizeable resource. Exxon Corporation states that each drilling vessel costs \$70,000 a day to operate. Each of the 59 exploratory wells in the Hondo Field off Santa Barbara costs between \$2 million and \$5 million to drill. Isn't this capital better spent on developing OCS areas where the risks presented by rough seas and unstable geologic conditions are less significant and where the potential benefits to be derived are far greater?

I am not suggesting a halt in oil and gas exploration and development on the OCS. I am suggesting that we, as public officials, must act responsibly to weight fully all options in terms of benefits and burdens.

Perhaps the questions raised ultimately can be answered to your satisfaction and that of most North Coast residents. However, many of my constituents, and responsible state and local officials, are telling me that there is no way these questions can be addressed satisfactorily, given the proposal's current scope, by May of 1981, the projected date of Lease Sale No. 53. I believe this is the case and therefore believe that the lease sale should be delayed and modified in scope.

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#### PREPARED STATEMENT OF GARY A. PATTON, SANTA CRUZ COUNTY SUPERVISOR

My name is Gary A. Patton. I am a Santa Cruz County Supervisor, and have been a County Supervisor for the past five years. I am a former member of the Central

Coast Regional Zone Conservation Commission, and am past Chairperson of the Monterey Bay Unified Air Pollution Control District. I am acting as Coordinator for a group of local officials, including representatives from each County within the OCS Lease Sale No. 53 area, and a number of affected cities.

The Select Committee on the Outer Continental Shelf apparently well understands the problems which local officials and state officials find in proposed Lease Sale No. 53. The Committee's Chairman, the Honorable John M. Murphy, illuminated many of the problems in his opening statement at the Committee hearings held in San Francisco on August 29, 1979. Likewise, the briefing paper prepared for the Committee outlined a number of the problems quite concisely. I am enumerating the problems here so as formally to put myself on record that these problems do, in fact, exist and are of substantial concern to local government.

1. The extent of the resource likely to be found in the OCS Lease Sale area is small. The Sale area includes virtually the entire central and northern California coast, and yet USGS resource estimates indicate only about 30 days total national supply of petroleum in the entire Lease Sale area.

2. The quality of the resource is relatively low. It is anticipated that the crude oil to be developed will be mostly "sour" crude, refinery capacity for which is not presently available in California.

3. While OCS No. 53 is being treated in a single proceeding, in fact five different basins are involved, each with different resource potential and environmental and other associated problems. An accurate determination of the costs and benefits of the proposal is not possible because a logical unit of analysis is not being employed. The Lease Sale should be carried forward, if at all, as five separate lease sale proceedings.

4. In almost every part of the OCS No. 53 Lease Sale area, the onshore impacts of OCS development would be horrendous, since they would be such a major change from the existing land uses. The affected central and northern California coastline is largely rural and undeveloped. Agriculture, tourism, and fisheries are the major industries along the affected coastline.

5. The baseline studies which should precede any reliable determination on whether or not to go ahead with Lease Sale No. 53 have not been completed, and in many cases have neither been funded nor even begun. The information, thus, to balance the environmental effects against the economic benefits, which information is required to be developed under the OCS Lands Acts Amendments, is not available.

6. Proposed Lease Sale No. 53 will have extremely significant adverse air quality impacts in several impacted air basins in California.

7. The proposed development while not promising much in the way of production, promises great potential risks to the major economic activities along the affected coastline, namely to tourism and to the fisheries.

8. The environment in much of the proposed Lease Sale area is extremely fragile, and there is an inadequate ability to deal with oil spills since no adjacent industrialized areas exist, nor is there adjacent petroleum production.

During the Committee hearings in San Francisco on August 29, 1979, members of the Committee noted that in indicating those tracts where an Environmental Impact Statement would be prepared, the Secretary of the Interior deleted a large number of acres from the initial call for nominations. Local officials are not comforted by the Secretary's action for three reasons:

1. Any fairminded evaluation will show that the Secretary left in virtually all those areas where resource potential had been noted, and where there was high oil company interest. In other words, he made no deletions of anything that the oil companies were interested in (with a couple of notable exceptions around areas of extremely high biological interest).

2. Local governments spent many thousands of hours developing negative nominations to convince the Secretary that there were a good many areas of high risk to the environment, or to onshore economic activities like fishing and tourism, and where there was low resource potential, and where the process should be terminated immediately. By terminating the process immediately, the federal government, and the affected state and local governments, would not need to undertake the cost of environmental and other studies. In fact, none of these areas were deleted.

3. As indicated in number 1, the Secretary of the Interior did make a few deletions in areas of significant biological interest. Where such deletions were made, additional tracts were added in other areas, so that the number of tracts remained virtually the same.

State and local governments having participated very aggressively in the negative nomination process saw no responsiveness whatsoever at the Departmental level to

any of the comments they made. In fact, the process is proceeding wherever resource potential was identified in the oil companies' indicated interest. We feel this is contrary to the requirements of the Act, and certainly good practice. The studies which would be required to balance the risk to the environment against the potential resource availability in fact are not funded and have not even begun in many cases.

OCS No. 53 and other outer continental shelf sales are supposed to represent this nation's response to an energy crisis. Our energy crisis is caused by the highest per capita consumption of energy of any national in the world, and our extreme reliance on nonrenewable resources. Oil and gas are such nonrenewable energy resources. Further exploitation of nonrenewable resources in the OCS in fact is not a solution to our energy problem, but it is a continuation of the problem. We are digging the hole deeper. The Honorable Don Clausen's suggestion that the California OCS should be maintained as a national security reserve is consistent with this thought. These supplies should be treasured against the day when we truly need them in times of extreme national crisis. It is foolish to take reserves which are relatively easily accessible and use them up, since they will not directly alleviate the energy crisis we face, only forestall it for a limited number of years.

The Governor of California, and the State of California, are attempting to do things which would truly alleviate the energy crisis. We are attempting to utilize and maximize the use of renewable energy sources, for instance, cogeneration, small hydroelectric generation capacity, geothermal capacity, biomass conversion, plus getting "new production" of energy by conservation measures, and by increasing the "productivity" of our current energy supplies. This in fact is the only way, in the long run, we can solve our national energy crisis. The crisis is caused by a reliance on nonrenewable energy sources. As we exhaust those sources, the price naturally rises, and scarcity gets worse. Of course, California is also increasing its production of petroleum supplies.

Politicians should be able to be candid with one another. As politicians, we all know that when a genuine crisis is at hand, it is important that the government in fact do something about it. It sometimes seems more important to politicians, however, that the government appear to do something about a crisis than actually to do something, since politicians often are not reelected if the citizenry does not believe that appropriate steps are being taken. I think that the development of the OCS is intended to give the appearance of robust efforts to solve our energy problems. It does give this appearance, but the reality is otherwise. The resource content of OCS No. 53 Lease Sale area is small; the quality of the resource is poor; and it will be a good number of years before any energy production whatsoever can be expected from the Lease Sale area. This is particularly true since there are no supporting onshore facilities in most of the areas where production will occur, and since there will be a good many environmental battles and local government resistance to the development of such onshore facilities. In fact, if the development on a prompt basis of energy supplies is what is required, OCS No. 53 is not the answer. It does, though, seem to be progress, and this is important in terms of appearance.

I suggest that OCS No. 53, and undoubtedly some of the other lease sales with which I am not personally familiar, are being pushed in pursuant of a political plan to give the appearance of action at the national level, in lieu of actually being action itself.

I suggest that the following should occur, and believe that your Committee should initiate the appropriate legislation to make it occur:

1. OCS Lease Sale No. 53 should be terminated forthwith.
2. A five-year program should be developed consistent with the OCS Lands Acts Amendments.
3. Baseline environmental studies and further research by the Department of Energy and the USGS on the resource potential of the OCS No. 53 area should go forth, so that the five-year program can be based on the genuine knowledge rather than speculation.
4. Leasing in the future can be based, once information is available, on a true balancing of resource potential versus the political impacts on the environment and economies of the affected local and state governments.
5. The Committee should seriously consider declaring the northern and central California coast in the OCS Lease Sale No. 53 area a national security reserve area, and the oil should be retained in situ for times of extreme national emergency.

Thank you for taking my thoughts into consideration.

TOMALES BAY ASSOCIATION,  
Point Reyes Station, Calif., August 30, 1979.

To: House Select Committee on the Outer Continental Shelf.  
From: William S. Howe, Jr., President, Tomales Bay Association.

HONORABLE MEMBERS OF CONGRESS: The Tomales Bay Association, an organization of individuals and property owners from the communities surrounding Tomales Bay, Marin County, California, is pleased to be one of several local organizations represented by the oral testimony of Ms. Susannah Jacob, Chairman of the Environmental Action Committee of West Marin. While the different local organizations have different specific concerns, and sometimes varying viewpoints, in local matters, we frequently unite on matters of common concern, such as O.C.S. Lease Sale No. 53. However, it has been a very long time, in my experience, that so many organizations have banded together over a particular issue, which phenomenon is a consequence, I believe, of the degree to which we consider this lease sale to be a threat to our environment and way of life.

Our fears, I further maintain, are not without foundation in fact. My wife and I have for several years now attended various conferences dealing with the lease sale process, many of these having involved participation and even sponsorship by the Bureau of Land Management. There has been little if any secrecy about the process, at least for those who have wished to avail themselves of the information available. Among other types of information has been emphasis upon the increasing role of two things: (1) the openness of the bureaucratic process to public input and most especially to input from state and local government; and (2) a new emphasis upon the obtaining of environmental information prior to the offering of tracts for sale. The latter was to receive especial consideration in the case of Lease Sale No. 53, located in a so-called frontier area.

Several years ago, in the latter regard, my wife and I were privileged to attend a conference held at San Francisco State University under B.L.M. sponsorship for the benefit of primarily scientists specializing in the areas appropriate for investigation. One got the impression that a substantial inquiry was about to be launched. For a long time, there was little evident follow-up, merely rumors that B.L.M. was settling for a review of the literature. Yet the conference has in fact revealed the almost complete absence of the most fundamental scientific knowledge about a large geographic area, thought to be of great environmental sensitivity. I have recently learned that B.L.M. did in fact sponsor several scientific studies. I would submit to your consideration as a line of inquiry, whether in fact the half dozen or so studies undertaken will be quantitatively sufficient for the purposes for which they have been commissioned. One way to find this out is to ask the scientists specializing in this area. It is my recollection that the famous marine biologist Dr. Joel Hedgepeth of Santa Rosa, the former head of the Marine Biology Station at Dillon Beach, was in attendance at the S.F. State conference, and perhaps he can be of help to you in this matter.

Secondly, I will reiterate the point I am sure others will mention about the question of the timetable of this lease sale relative to the availability of the results of the contracted for information. Not all those studies will have been completed in time for the scheduled preparation of the DEIS. This fact raises a question about the sincerity of BLM in the strict observance of the statutory requirement to weigh environmental considerations against the energy procurement consideration. Needless to say, it is not correct procedure for BLM to give substance only to the energy procurement side of the process. It must give as much substance to the other statutory requirements as the law requires. And one does get the impression, at least, that BLM's administration of the environmental requirements is at best less than whole-hearted.

In regard to the openness of the process, I cannot speak with authority because of the limitations on my own participation. However, I have not personally had reason to complain. Representatives of the Los Angeles office of BLM have appeared publicly at the various hearings I have attended and have listened to whatever has been said. One letter I wrote to the Secretary of the Interior was cordially—and unexpectedly—answered in some detail by the proper authorities in Washington. However, you must understand that rightly or wrongly, current sentiment is widespread that local public protest is listened to—and then ignored. The process appears to us as a relentless steamroller, which smiles and listens to its victims as it mindlessly proceeds to flatten us on its programmed course.

There is no point in repeating what I know you will hear from oral testimony today about the unique contribution of the Northern and Central California coastline to the recreational needs of countless numbers of people. Knowing these facts, the federal as well as the state and local governments have invested large sums of



money in its preservation. It would appear short-sighted to reverse that goal for so little anticipated return from an energy source now widely believed to be of declining importance over the long term.

One final point that I have personally been stressing to interested parties is that as appreciative as we all are in West Marin to Congressman John Burton and the Congress as a whole for putting a fifteen mile buffer area between the Point Reyes National Seashore and the first drilling platform, we must remember the limitations of that measure as to safety in the event of danger. The winds and waves and currents in this area will totally nullify that buffer zone in the event of a spill or even from air pollution from tankers picking up oil from offshore, should that type of operation be employed. This fact is readily observable by anyone and will only most assuredly be verified by any expert testimony you may need. There is simply no environmental security to this area from far to the North.

For the rest, I think I will simply defer to the oral testimony of Mrs. Jacob and her co-panelists.

Thank you.

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TOMALES BAY MARINE LABORATORY,  
Marshall, Calif., August 27, 1979.

COMMITTEE ON THE OUTER CONTINENTAL SHELF,  
*Congress of the United States, Washington, D.C.*

I would like to bring to your attention a Special Issue of the Journal of the Fisheries Research Board of Canada (Vol. 35, No. 5, May 1978) on the "Recovery Potential of Oiled Marine Northern Environments". This issue contains 37 articles on the long term fate of petroleum hydrocarbons after spills, physiological stresses in chronically oiled organisms and the long-term effects of oil spills in marine intertidal communities written by experts in research on oil pollution.

The findings reported suggest that serious consideration should be given to the long-term effects of spills on coastal habitats, particularly near-shore shallow-water and intertidal soft substrate habitats such as sands and muds, especially in areas such as Tomales Bay. Among the pertinent findings consideration should be given to (1) the persistence of effects of oil spills 5-15 years after the spill, (2) stressful physiological effects of oil at sublethal concentrations on marine organisms, and (3) very slow natural degradation of oil in habitats such as muds where aerobic microbial activity is low. In an area such as Tomales Bay in which shallow water and intertidal mud and sand habitats predominate, incursion of oil would have serious long-term effects on the biota, including natural resources such as herring and other fish and shellfish. I believe that these considerations should be given strong weight in any cost-benefit assessments of the desirability of siting oil drilling and transport operations along the coast of Northern California. Tomales Bay, in particular, is the least polluted, faunistically most diverse bay in California and an important resource for biological research on coastal marine biota and habitats. An oil spill incursion into the bay would greatly diminish its value as a natural resource, including the fisheries, mariculture, research and recreational activities in the bay.

Consideration should be given to the potential for substantial along-shore transport of spilled oil along the Northern California coast. Drift bottles released off Bodega Head have been recovered not only in Tomales Bay but in Newport, Oregon, San Francisco Bay, and Monterey Bays, dozens or hundreds of miles away. There is considerable along shore sediment transport. For instance, Russian River sediments enter Tomales Bay. Rapid and unpredictable changes in local currents occur, whatever the prevailing seasonal current directions may be. (R. J. Hamby, Drift Bottle Studies at Bodega Head, California, Pacific Marine Station Research Report, 1964, 44 pp.; C. C. Daetwyler, Marine Geology of Tomales Bay, Central California, Pacific Marine Station Research Report No. 6, 1966, 169 pp.; Reports available from Tomales Bay Marine Laboratory Archives.) The foregoing findings suggest that the potential for rapid transport of spilled oil long distances along the California coast and outline the need for more detailed studies of offshore currents and their potential for transport into important natural areas along the shore.

The available reports are included with this letter for your consideration.<sup>1</sup>

Sincerely yours,

STEVEN OBREBSKI, PH.D.,  
*Co-Director and Resident Ecologist.*

[COMMITTEE NOTE.—A sampling of the hundreds of letters the committee received concerning lease sale No. 53 follows:]

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<sup>1</sup> The reports are on file with the committee.

CALIFORNIA COASTAL COUNCIL,  
*Santa Barbara, Calif., September 10, 1979.*

Congressman JOHN MURPHY,  
*Chairman, Outer Continental Shelf Committee,*  
*Washington, D.C.*

DEAR CONGRESSMAN MURPHY: The California Coastal Council is a Statewide organization concerned with the environment and the need to preserve and protect our natural resources; but formed to insure that in our desire to accomplish those valid social goals, that people's right are not swept away in the name of improving the quality of life.

It is the Council's observation that those in opposition to Federal O.C.S. Lease Sale No. 53 have no valid reason to delay this project, and, in fact, are acting contrary to the National interest in doing so. The California Coastal Commission, with whom our organization is very familiar, has taken an unreasonable and unrealistic position with regards to this matter. Upon examination of the facts, we find that they have distorted information, ignored pertinent published studies, and have failed to substantiate their conclusions with facts. We believe that the staff recommendations are arbitrary and subjective. We must, therefore, conclude that their recommendations serve no purpose but to delay or block the pending sale.

The Coastal Council cannot support waiver of mitigating measures aimed at providing protection against environmental damage, in our quest to explore and develop our energy resources. This, however, is not the case in Lease Sale No. 53. Stringent environmental protective measures are already required and in our opinion, are adequate. Coastal Commission staff recommendations would simply overlap existing regulations, call for redundant studies, with no improvement in the end result. The additional layer of red tape would only serve to jeopardize the viability of exploration and extraction of critical domestic petroleum resources.

We feel that the Commission's recommendations should be viewed in their true light, a negative response which will hinder the National effort to deal with the current energy crisis and our dependence on foreign petroleum.

We urge your Committee to consider the National energy needs, as well as environmental considerations which must be presently dealt with, and discount the Commission's recommendations as superfluous, serving no useful purpose.

Very truly yours,

JOHN MAYFIELD,  
*Chairman of the Board.*

WHALE CENTER,  
*Oakland Calif., August 27, 1979.*

Hon. JOHN MURPHY,  
*Chairman, House Select Committee on OCS,*  
*House of Representatives, Washington, D.C.*

DEAR MR. MURPHY: The Whale Center is a nonprofit organization working on public education about whales and on whale conservation. Our concern for whale conservation includes safeguarding the habitat of whales and other marine creatures. Because of this concern we are happy to have this opportunity to express our views on OCS leasing in general and Lease Sale 53 in particular to the House Select Committee.

Our first concern is that not enough is known about adverse impacts on living resources to be anticipated from increasing ship traffic, drilling activity, and the resulting increase in noise. There will be increasing risk of oil spills, but little is known about the effect of oil on marine mammals, especially whales.

A new inventory of marine mammals along the Pacific Coast is now authorized and the contract let. But it is impossible for the results to be available before the scheduled leasing in February, 1981. In addition, a proposed project to study the effect of oil on marine mammals has not even been funded yet. What this means is that decisions are being made without the benefit of full disclosure of the facts on numbers of marine mammals, and the expected effect of environmental impaction and oil spills on them.

The current energy crunch appears to be stimulating this headlong rush into development of all possible energy resources, including OCS, except the most significant, immediately available resource: conservation in use of present energy supplies. Without a mandatory national conservation program, the policy instead is to develop and use up all our domestic resources as quickly as possible. The public is expected to sacrifice scenic and natural values in order to exhaust small amounts of

precious oil available in the Northern California lease sale. When the oil is gone the public will be left with no reserve and with possibly impaired natural values. These two losses are not necessary—at least not now—when a national program of conservation could save more oil than can be recovered from these hasty OCS leases. And conservation need not impact significantly on the American standard of living.

We oppose Lease Sale 53, and others that will impact on natural and scenic values. We object to the proposition that this generation should exhaust oil supplies that may be desperately needed in the future for manufacturing and agricultural purposes. Our objection is strengthened by the fact that the United States continues its wasteful practices with existing energy supplies.

I would like to stress again that leasing decisions are being made without the benefit of basic information on the marine environment and its inhabitants. These decisions should be considered only after all the facts are in, and after a real conservation program is well underway.

The OCS review process develops its own momentum. Despite the fact that public input is allowed at certain stages, the momentum gathers force and overwhelms public views. We appeal to this House Select Committee to take steps that will result in the delay of the whole OCS leasing program. It is in the public interest to get the information on the marine environment and its living resources before leasing decisions are made. It is in the public interest to embark on a national conservation of energy program before OCS reserves are used.

Thank you for this opportunity to express our views.

Sincerely yours,

MAXINE MCCLOSKEY,  
*Executive Director.*

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ASSOCIATION OF MONTEREY BAY AREA GOVERNMENTS,  
*Monterey, Calif., September 5, 1979.*

Hon. JOHN MURPHY,  
*Chairman, House Select Committee on the Outer Continental Shelf,  
Washington, D.C.*

DEAR CONGRESSMAN MURPHY: As you know, the amendments to the OCS Lands Act have provided for greater participation by local governments in the Outer Continental Shelf oil and gas leasing process. We intend to make the best use of this opportunity.

The goals of our OCS No. 53 Planning and Information Program are to:

"Provide information on all pertinent issues relating to OCS oil and gas development at a level readily understandable by non-technical individuals. Participation in the process is impossible without understanding it.

"Raise key issues relating to potential impacts on the region for consideration by all those concerned.

"Evaluate federal documents and decisions from a local perspective, by coordinating all regionally available expertise from local governments, academic and citizen groups and individuals. The majority of this effort will be aimed at the Draft Environmental Impact Statement, now being prepared by the Bureau of Land Management (BLM) and scheduled for completion in April of 1980.

"Respond to the federal government on all OCS matters which are of local concern. Responses will most likely take many forms, ranging from identifying inadequacies in their environmental study work plan to recommending specific inclusions of technical data into the EIS or pointing to the need for particular research. The responses will be as varied as the issues."

As AMBAG Board President, I have observed that the majority of local officials and many concerned citizens are very anxious to express their deep concerns over the potentially serious and adverse effects that could occur as a result of OCS operations off the central California coast. Our CEIP fund planning and information program will serve as the vehicle for expressing those concerns. To that end, I respectfully submit the following concerns and issues.

Even in the short period of time, those involved with the program, including myself, have come to realize that we are asking questions and raising issues that go to the very heart of this nation's future survival. At the very least it is our duty to ensure that those difficult questions are raised and debated in full public view.

Local input and evaluation of the OCS planning process is essential to our region. AMBAG is taking steps to ensure that local people can stay informed of the leasing process and voice their opinions before a final decision is made. Information Papers will be released periodically, and are available to the public. Two Advisory Committees have been formed to guide the regional response to Federal OCS products and

actions. A policy level committee is composed of the AMBAG Board of Directors and elected officials appointed as OCS liaisons by their respective jurisdictions. A Technical Advisory Committee has been organized to provide access to concerned citizens in the region and to assist AMBAG staff in developing OCS related products.

As a result of our work and the meetings of the Technical Advisory Committee I have compiled the following list of issues that appear to be foremost in the thinking of those involved with the program. These issues need to be brought before the decision making bodies at all levels of government and resolved to some conclusion before the scheduled lease sale of February 1981 for our area.

1. How will OCS Lease Sale No. 53 fit into the national energy needs picture? Will it make any meaningful contribution towards the concept of energy independence? For that matter does the entire national scope of OCS leasing make a significant contribution when weighed against the economic and environmental cost?

2. We seem to be entering an age of national comprehensive energy and resource planning. Given that direction, shouldn't we be evaluating our oil reserves for their use in the fabrication of such things as fertilizer, medicines, clothing and building materials for the next generations, rather than rushing to exploit them today primarily for gasoline?

3. There seems to be no argument that as a nation we waste too much fuel—given this situation it seems only logical that we should first move to use more efficiently the resources we have before exploiting new sources. If conservation practices can save as much fuel as we might obtain from lease sale No. 53 then we will all be better off because we will still have the reserve for what may be a far greater need in future years and in addition we will have made a significant step forward towards a way of living that creates less waste and less pollution. This type of conservation strategy should be made a necessary input to the decision making process.

4. If it is determined to be in the best national interest to investigate the true potential of our offshore resources in OCS lease sale area No. 53, then surely it would also be in the best national interest to conduct this survey and exploratory work by an agent of the U.S. Government (perhaps USGS) and not by a private corporation. The potential oil and gas reserves belong to the nation and we have a vested right to know how much we have. We would never allow a private lumber company to make their own count of the number of trees in the national forest and then grant them a permit to cut before our own Forest Service had determined the volume and nature of the resource.

5. Under the present leasing procedures there seems to be no way to half production once leasing and exploration takes place. A provision should be created for the designation of a national strategic reserve status so that actual production could be timed in accordance with national needs.

6. Our information indicates that the west coast does not have the refinery capacity to process what may well prove to be very low quality crude oil and the BLM has produced a transportation scenario calling for movement of OCS 53 crude to Galveston, Texas. Is this a rational way to approach energy independence given the costs and risks of moving the oil over 5,000 miles?

7. The Energy Mobilization Board, as called for by the President, would have power to waive all types of procedural requirements now in effect. How can we be assured access to decision making if this occurs?

In addition to the above general policy concerns, we are also developing a number of technical and environmental issues that will be used to evaluate the draft environmental impact statement now being prepared by the BLM. At the moment the question of air quality impacts appears to be of foremost concern due to the inconsistency created by conflicting federal policies. On the one hand we are working hard to achieve good air quality standards by control of onshore emissions, while at the same time, the proposed OCS Air Quality Rules (F.R. Vol. 92/May 10, 1979) would treat OCS related air pollution as "external to the onshore areas whose air quality they may affect" (p. 27450).

Once again, thank you for your interest and assistance in this crucial matter.

Sincerely,

FRANK E. OSMER,  
*President, Board of Directors.*

UNIVERSITY OF CALIFORNIA,  
BODEGA MARINE LABORATORY,  
Bodega Bay, Calif., August 29, 1979.

Hon. JOHN MURPHY,  
Chairman, House Select Committee on Outer Continental Shelf,  
House of Representatives, Washington, D.C.

SIR: For the information of the House Select Committee on OCS dealing with the proposed lease sale off Bodega Head, I wish to describe the dependence of the Bodega Marine Laboratory's research program on the coastal resources in this area. Our institution will not be represented at the hearings presently being held in San Francisco and in Marin County.

Bodega Marine Laboratory is situated on a biological reserve maintained for the study of undisturbed populations of coastal species of plants and animals. This location was chosen before the lab opened in 1965 in order to be sufficiently remote from pollution sources in San Francisco Bay. The wide variety of studies currently using the resources of this area can be seen from the accompanying list of Bodega Marine Laboratory research projects.

In addition, these and many other projects, most notably a large Sea Grant supported program of crustacean aquaculture, depend on a continuing supply of clean seawater flowing throughout our laboratories. This requirement is central to our continued success. Thus we are very interested in providing any information or help which may be useful in determining whether the lease sale should proceed.

Sincerely,

PETER G. CONNORS,  
Assistant to the Director.

Enclosure.

The 1978-79 Research Projects within proposed Pt. Reyes National Marine Sanctuary conducted at Bodega Marine Laboratory, University of California, Bodega Bay, California.

*Project title—Principal investigator(s)—Funding.*

1. The economics of fisheries and aquaculture development: cycling of Dungeness crab populations—Johnston/Hand—NOAA Sea Grant.
2. Survey of genetic variation in barnacles of the Pacific coast—D. Hedgecock—Am. Phil. Soc.
3. Ion and water transport by teleost urinary bladder—T. Machen—NSF.
4. Population genetic structure in abalones—D. Hedgecock—NSF.
5. Factors of non-breeding habitat in shorebird social systems—F. Pitelka—NSF.
6. Coastal wetlands management: the role of algal wrack in sand beach community dynamics—F. Pitelka—Sea Grant.
7. Reproductive strategies and behavior in the surfperches: *Embiotocidae*—M. Noble—graduate research.
8. Uptake and disposition of chemicals by *Mytilus californianus*—R. Krieger.
9. Transport of dissolved organic materials by phoronid worms—J. Crowe.
10. Fluxes of organochlorine pollutants through the marine environment—F. Risebrough—NSF.
11. Participation in the U.S. Mussel Watch Program—R. Risebrough—EPA.
12. Natural regulation of animal populations: California *Littorina* populations—V. Chow—graduate research.
13. Reproductive biology of *Epitonium tinctorum*—K. Breyer—graduate research.
14. Reproductive and population biology of the sea anemone *Metridium senile* (L.) on the coast of central California—A. Bucklin—graduate research.
15. Algal-grazer interactions in the rocky intertidal zone—W. Sousa.
16. Natural history of hydroid and bryozoan epiphytes of brown macroalgae.—C. Tarp—graduate research.
17. Investigations of the amphipod *Allogausia recondita*, an associate of the sea anemone *Anthopleura elegantissima*—W. Vader.
18. Growth of the intertidal gastropod *Notoacmea scutum*—D. Phillips.
19. Differences in defensive behavior between sexes of the gastropod *Tegula funebris*—D. Phillips.
20. Isolation and characterization of the chemicals triggering defensive behavior of marine invertebrates—D. Phillips.
21. Substrate specificity and settlement behavior of larval *Urechis caupo*—L. Suer—graduate research.

22. Natural history of the surfgrass *Phyllospadix* community—D. Fishlyn—graduate research.

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LEAGUE OF WOMEN VOTERS OF MARIN COUNTY,  
*San Rafael, Calif., August 30, 1979.*

COMMITTEE ON THE OUTER CONTINENTAL SHELF,  
*House of Representatives, Washington, D.C.*

HONORABLE COMMITTEE MEMBERS: The League of Women Voters was gratified by the passage of the bill introduced by Congressman Burton exempting the area within 15 miles of the Point Reyes National Seashore from oil and gas drilling. We also supported the preparation of an EIS on Marine Sanctuary status for the Point Reyes and Farallon Island region. We feel that this unique region, which belongs to all the citizens of this country, ought to be preserved. However we realize Congressman Burton's bill preserving the area within 15 miles of the coast would not give adequate protection if drilling is permitted in the area specified in OCS 53. The Point Reyes National Seashore and the Golden Gate National Recreation Area are down wind from the area specified in this lease. The prevailing wind and water surface action would move any oil or air pollution resulting from drilling in this area into the Point Reyes National Seashore with its irreplaceable natural resources. Since the oil will be transported by barges rather than pipeline, it will increase air pollution downwind.

Although we recognize the national need for additional oil and gas, we question whether the projected amount of fuel that can be extracted from these tracts is worth the potential environmental damage to this publicly owned resource. It is our understanding that the U.S.G.S. estimates that there will be only a potential total production of 8 million barrels of oil and 8 million cubic feet of natural gas from these eight tracts. In terms of our current consumption of oil that is only enough to supply this country for ten hours. We hope you will weigh these figures as you make your decision.

Respectively,

BARBARA FUCHS,  
*President.*  
BETH SHORE,  
*State Program Director.*

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COASTAL ALLIANCE II,  
*Sacramento, Calif., September 10, 1979.*

HON. JOHN MURPHY,  
*Chairman, House Select Committee on the Outer Continental Shelf,*  
*Washington, D.C.*

DEAR CONGRESSMAN MURPHY: The California Coastal Alliance would like to thank you and your committee for coming to California to hear how the people that live and work here feel about the Off shore oil leases. While technology has certainly speeded up communications, there is no substitute for face to face discussions.

My impression is that people here feel that the local concerns were all expressed in one way or another during the testimony. That you and the committee were here in person seemed a little closer to democracy in action. It is also clear that you do not have too much leeway for action; however a bottom line position would seem to be that there should be no action until sufficient information can be gathered and analyzed.

We are looking forward to hearing what actions your committee will be taking regarding the offshore oil Lease Sale #53.

Sincerely,

PHYLLIS FABER,  
*Board of Directors.*

POINT REYES BIRD OBSERVATORY,  
 Bolinas, Calif., September 11, 1979.

Hon. JOHN MURPHY,  
 Chairman, House Select Committee on Outer Continental Shelf,  
 House of Representatives, Washington, D.C.

DEAR CONGRESSMAN MURPHY: We are a private, non-profit research corporation supported by about 2,000 members, corporate donations and some government contracts. We have been gathering baseline information on the wildlife and ecology of the Point Reyes area and the Farallon Islands and vicinity year round since 1965 and 1968, respectively. The emphasis of our work is on marine, estuarine and insular environments. Since we have also from time to time conducted studies far afield, in such places as Alaska and Antarctica, our perspective is both focused and broad. We have published over 200 scientific papers, books and reports.

With such a background we feel qualified to voice an opinion on matters potentially effecting the marine and estuarine ecology of central California, if we have concrete information to offer, in this instance, the proposed leasing of offshore oil drilling tracts in California. We generally maintain a low political profile but pride ourselves in the basic information we have supplied to various issues. We feel that if political processes involve the truth, as much as humanly possible, then ultimate decisions will likely be good ones.

In terms of Lease Sale 53 we ask that known facts about ecological impact and oil yield potentials be incorporated and weighed in the final decision. As it now stands, the one year environmental study by BLM is inadequate due to its shortness because of the great annual variability in biological processes, the size of the area being considered and some of the survey techniques being employed. Moreover, the BLM study expressly avoids attention to the Farallon Islands National Wildlife Refuge and the Farallon Wilderness Area. These islands, just 40 miles down stream of the Sonoma County lease area, hold large populations of marine mammals (5 species breed there) and the largest single concentration of breeding seabirds (12 species) in the U.S. outside of Alaska and the Leeward Hawaiian Islands. Besides the expressly protected mammals (Marine Mammal Protection Act of 1972), two endangered species reside there as well, the Peregrine Falcon and California Brown Pelican. For BLM to ignore these populations in their study and even the 9 year data base already available for them is incomprehensible to us. Such information as population sizes, annual productivity and mortality, diets and feeding ranges are available but has yet to be analyzed. The data base here is in fact far more extensive than that collected for the Southern California and Alaska lease sale environmental studies on marine birds and to some extent mammals. Given more time, BLM might awaken to the value of this information. To ignore it will not provide an adequate environmental assessment. The role of politics alone in the final decisions then may well disproportionately outweigh consideration of what proveable facts are available.

Sincerely yours,

DAVID G. AINLEY, PH. D.

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AUDUBON CANYON RANCH,  
 San Francisco, Calif., September 3, 1979.

Hon. JACK MURPHY,  
 Chairman, House Select Committee, Outer Continental Shelf,  
 Washington, D.C.

DEAR CONGRESSMAN MURPHY: At a regular meeting on September 1, the Board of Directors of Audubon Canyon Ranch passed the following resolution on offshore oil drilling.

Whereas Audubon Canyon Ranch owns ecologically sensitive and valuable property along the shores of Marin County, as well as other sensitive and valuable pieces of tideland and marshland wildlife habitat; and

Whereas members of the staff and Board of Directors of Audubon Canyon Ranch were among those who struggled to win a narrow victory over the oil which spilled and threatened to destroy the marine and avian life of Bolinas Lagoon in 1971; and

Whereas Audubon Canyon Ranch is especially interested and involved in the protection and well-being of two immensely important tidal bodies in Marin County: Bolina Lagoon and Tomales Bay now, therefore, be it

*Resolved* by the Board of Director of Audubon Canyon Ranch at a regularly called meeting on September 1, 1979 in Marshall, California, that no drilling for oil be

permitted off the shores of the counties of San Mateo, San Francisco, Marin, or Sonoma.

Sincerely,

AILEEN PIERSON, *Secretary.*

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LEAGUE OF WOMEN VOTERS OF CALIFORNIA,  
*San Francisco, Calif., September 5, 1979.*

Hon. JOHN M. MURPHY,  
*Chairman, House Select Committee on Outer Continental Shelf,*  
*Washington, D.C.*

DEAR CONGRESSMAN MURPHY: The League of Women Voters of California and several local coastal Leagues are following the offshore oil debate with interest and concern. Several League members attended the San Francisco and Marin County hearings held last week. We wish at this time to share with you and your committee members our concerns regarding Lease Sale No. 53.

While the League recognizes that offshore oil must be considered as an energy source, we also believe that the public must have full and adequate input into a final OCS decision. We, along with other members of the public, have felt somewhat frustrated at the lack of adequate notification of meetings and hearings. A sincere effort by the federal government to involve local governments and the public in the decision making process must begin with better and more timely notification procedures.

Secondly, we question whether there is indeed a neutral mediator in the OCS process. It appears that all the federal departments involved, including the Department of Justice, have some vested interest in the final decision. To whom should the public look as a facilitator when there are cases of dispute?

Finally, and perhaps most serious, is the lack of baseline data for consideration in making a final decision on the lease sale. Any EIS completed without the support of baseline data does not assure environmental protection. The League cannot support a process which make a final decision without supporting data.

Given the lengthy lead times for OCS exploration, drilling and production, the League feels that some additional time must be taken now to address the issues outlined above. The coastal resources of California, the quality of our air, and the protection of our environment deserve more careful consideration than is being afforded by the present OCS process.

The League of Women Voters of California urges you and your committee to make certain that OCS development is not rushed at the expense of California's environment.

Sincerely,

SUSAN RICE  
*President.*

PHYLLIS PRICE,  
*Energy Director.*

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STINSON BEACH VILLAGE ASSOCIATION,  
*Stinson Beach, Calif., August 13, 1979.*

JOHN MURPHY,  
*Chairman, Outer Continental Shelf Select Committee,*  
*Longworth Building, Washington, D.C.*

DEAR CHAIRMAN MURPHY: The Stinson Beach Village Association would first like to thank you for the concern your committee is showing by visiting this area about which you must make such hard decisions.

Secondly, we are enclosing a copy of our July 3, 1978 letter to the California Coastal Commission endorsing the negative nomination of the entire off-shore area of the San Francisco, Marin and Sonoma coasts. We strongly feel that the potential risks are far greater than the corresponding benefits. The Mexican oil blow-offs, more than anything else, points up how little we know about what can go wrong, and how unprepared we are to deal with the unforeseen.

There is far too much to lose for far too little gain.

Sincerely,

BARBARA E. ALBAN, *Co-Coordinator.*

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STINSON BEACH VILLAGE ASSOCIATION,  
*Stinson Beach, Calif., July 3, 1978.*

BRADFORD LUNDBORG,  
*Chairman, California Coastal Commission,  
San Francisco, Calif.*

CHAIRMAN LUNDBORG: The Stinson Beach Village Association voted unanimously at its July 1 meeting to endorse the negative nomination of the entire offshore area of this region by the North Central Coast Regional Commission.

The reasons for this negative nomination are clearly stated in their memorandum to you dated June 2, 1978. The Stinson Beach Village Association strongly agrees with these reasons and wishes to be on the record in support of this North Central Coast Regional Commission action.

Respectfully,

MARK WHITE,  
BARBARA E. ALBAN,  
*Coordinators.*

## NINETY-SIXTH CONGRESS

JOHN M. MURPHY, N.Y., CHAIRMAN

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 ABRAHAM KATZ, JR., TEX.  
 JOHN B. BREAU, LA.  
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 LEO C. ZEPHRETTI, N.Y.  
 DAVID E. BONIOR, MICH.

EDWIN B. FORSYTHE, N.J.  
 DON YOUNG, ALASKA  
 TRENT LOTT, MISS.  
 DAVID P. EMERY, MAINE  
 ROBERT L. LIVINGSTON, LA.  
 JERRY LEWIS, CALIF.

TIA GREGORY, CHIEF CLERK

## U.S. House of Representatives

Select Committee on  
Outer Continental Shelf

Washington, D.C. 20515

September 19, 1979

CHIEF OF STAFF  
 CARL PERIAN  
 MERCHANT MARINE AND FISHERIES

CHIEF COUNSEL  
 LAWRENCE J. O'BRIEN, JR.  
 MERCHANT MARINE AND FISHERIES

MINORITY COUNSEL  
 C. GRADY DRAGO

LIAISON  
 CARLA KISH  
 INTERIOR AND INDIAN AFFAIRS

Honorable Cecil D. Andrus  
 Secretary of the Interior  
 Department of the Interior  
 Washington, D.C. 20240

Dear Mr. Secretary:

As you know, on August 29 and 30, 1979, the House Select Committee on the Outer Continental Shelf held extensive field hearings in San Francisco and Point Reyes, California, on the implementation of the Outer Continental Shelf Lands Act Amendments of 1978 (OCS Act) and proposed lease sale #53.

The Committee heard a wide range of views on the Northern and Central California lease sale and the implementation of the OCS Act from Members of Congress, Department of the Interior, the Department of Energy, State witnesses, environmental groups, local county supervisors, and fishing interests, all of whom differed markedly on whether the OCS Act is being properly carried out in preparing for sale #53.

State, local, and environmental witnesses were nearly unanimous in their opposition to the sale and their belief that they have not been afforded the chance to make meaningful submissions regarding the leasing decisions involved in the sale. For example, commenting on the five-year leasing program and sale #53, Mr. Gregory Fox, Senior Energy Advisor, Governor's Office of Planning and Research, stated:

"....the spirit of consultation and close cooperation which were the hallmarks of lease sale #48 does not seem to be continuing."

Mr. Michael Fischer, Executive Director, California Coastal Commission testified that:

"...If the Interior Department were following Congress' mandate in the OCS Lands Act Amendments, so many representatives of local governments and environmental groups would not have to be before you at these hearings to oppose lease sale #53...Interior has failed to follow the letter and the intent of the OCS Lands Act Amendments...a year ago the Secretary of the Interior should have delayed this sale and...much of the proposed sale area should be deleted from the National five-year OCS Leasing Schedule. The history of lease sale #53 is the history of lop-sided implementation of the OCS Lands Act....We continue to express our extreme dissatisfaction with the limited role provided to the states under Interior's procedures."

Among other things opponents of the sale contend the following:

**\*\*First**, there is a concern that several necessary environmental studies have not been funded by the Bureau of Land Management, and that some of the studies initiated will not be completed in time for their results to be utilized in making leasing decisions.

**\*\*Second**, objections have been raised by the inclusion of such a wide area in one lease sale, particularly since there is a question as to whether the resource potential in some of the basins justifies undergoing the environmental and other risks involved. Exxon ranks the area as low in oil and gas potential.

**\*\*Third**, it was pointed out that because of refining and transportation problems, the West Coast "oil glut" would be exacerbated by development in the sale #53 area. California urged that it's increased contribution to the Nation's energy be first directed towards the development of abundant heavy oil onshore.

\*\*Fourth, severe weather conditions of the Northern and Central California area increase the risk of oil spills, and testimony from the United States Coast Guard affirmed that current oil spill clean-ups would be marginally effective in prevailing sea and weather conditions.

\*\*Fifth, State representatives condemned Interior's refusal to submit the Secretary's leasing decision to the "consistency requirements" of the Federal Coastal Zone Management Act.

\*\*Sixth, concerns about the risks of geohazards were reaffirmed by USGS testimony, which suggested that adequate time was not available under the present schedule to properly analyze seismic hazards.

\*\*Seventh, the air quality impacts of OCS development are of deep and genuine concern to the State of California, which feels that Interior's proposed air quality regulations will not adequately weigh the cumulative impact of offshore development on onshore air quality.

\*\*Eighth, it is widely charged that Interior has not afforded local governmental units and environmental groups an opportunity to make meaningful submissions prior to leasing decisions. They argue that the negative nomination process is ineffective and tract selection is largely impelled by industry and USGS resource potential estimates.

\*\*Ninth, local fishing interests state that the impacts on commercial fishing have not been given adequate study or attention.

\*\*Tenth, it is feared that OCS development will adversely affect endangered species and areas already protected by law or proposed for marine sanctuary designation, such as the Farallon Islands and the Monterey Bay area.

**\*\*Eleventh**, concerns are raised about onshore impacts, including the potential impacts of a large oil spill on the fishing, tourism and recreation pursuits, and air quality impact.

**\*\*Twelfth**, aesthetic concerns have been raised.

As you know the OCS Act seeks to enhance State and local participation in OCS decision making. Your policies in the past have been exemplary in that regard. However, lease sale #53 presents a crucial test, and a failure to properly adhere to congressional intent could prompt a legal challenge of the sale.

In March, 1979, Mr. Secretary, you were reported to have stated the following regarding opposition to certain aspects of sale #53:

"I would say they have valid concerns and complaints about potential damage of that sale and which leases should be left out... There is the possibility that sale #53 might be slipped in the schedule if it does not prove up...If it is disallowed, I would substitute in that time frame another sale so that the energy needs of America wouldn't slip."

Based on the testimony the Committee has received in San Francisco and Point Reyes, we have concluded that the lease sale in its present lease configuration demands especially close scrutiny by both the Select OCS Committee and the Executive Branch.

Accordingly, we urge you to consider the findings of the Committee and the following recommendations:

**\*\*The Interior Department** should proceed with all deliberate speed to complete the necessary environmental studies on the lease sale area, with particular attention given to the adequacy of seismic studies underway;

**\*\*If necessary**, a contingency sale should be considered and scheduled in the event that sale #53 is delayed;

\*\*Areas off Northern and Central California should be considered separately in balancing resource potential and energy needs with State, local, and environmental officials; and that development be presently considered only in high resource potential areas;

\*\*Top priority should be given to the merits of holding areas of lease sale #53 as a petroleum reserve; to be used only in time of a national security emergency;

\*\*We endorse the acceleration of heavy oil development onshore in California, and the enhancing of refining capacity through retrofitting;

\*\*High priority should be given to solving the West Coast petroleum transportation problem, and interagency efforts on this matter should commence immediately;


\*\*NOAA's State Participation Grant should be fully funded and supported by the Administration; and


\*\*Finally, the Interior Department should consider calling for industry nominations first to ease the burden of State and Local Government.

We look forward to a continuing dialogue with you on this vital matter. The OCS Committee has consistently supported expedited OCS development, albeit in a proper and environmentally sound manner, and the Committee reiterates its confidence in the effectiveness and integrity of OCS administration during your incumbency. For that reason, we reserve judgment as to the ultimate merits of sale #53, confident that you will reach a reasoned and acceptable decision once you have weighed all the facts, especially those adduced at our California hearings.


We would appreciate it if you would personally involve yourself in early lease sale #53 decisions, and we look forward to learning your preliminary reaction to the foregoing findings.

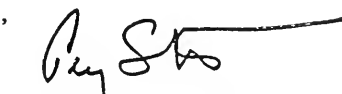
Sincerely,

  
JOHN M. MURPHY  
Chairman

  
WILLIAM J. HUGHES  
Member

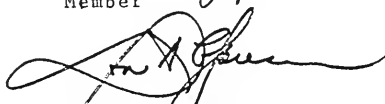
  
BO GINN  
Member

  
DAVID E. BONIOR  
Member

  
GERRY E. STUDDS  
Member

  
GEORGE MILLER  
Member

  
LEO C. ZEFFERETTI  
Member

  
DON H. CLAUSEN  
Member of Congress  
Committee on Interior  
and Insular Affairs

U.S. DEPARTMENT OF THE INTERIOR,  
OFFICE OF THE SECRETARY,  
Washington, D.C., November 14, 1979.

Hon. JOHN M. MURPHY,  
*Chairman, Select Committee on Outer Continental Shelf,  
House of Representatives, Washington, D.C.*

DEAR MR. CHAIRMAN: Thank you for your letter of September 19, 1979, based on the congressional hearings recently held in California on the proposed Outer Continental Shelf sale 53. I welcome this opportunity to discuss your recommendations with you in detail. However, I consider it important, so that misunderstandings can be minimized, to discuss the findings of the Committee reflected in the quotations and the summary of testimony made in opposition to the proposed lease sale #53. While my remarks are not as complete as the Departmental testimony given before the Committee at the hearings and the extensive briefings that have been given to both the Committee and Committee staff, they do highlight important points that need restating.

During my tenure, I have had as a major goal the realization of full, open, and productive relations with State and local governments and others that may be affected by decisions I make on energy development. For example, before the passage of the OCS Lands Act Amendments in 1978, I instituted by regulation most of the consultative requirements that are now law. Mr. Fox's and Mr. Fischer's comments on the lack of cooperation and consultation on sale 53 cannot be supported by the record. Sale 53 is in the beginning stages of planning that will continue for another year. Sale 48, to which it is compared by Mr. Fox, is a completed activity that spanned three full years of data collection, analyses, consultation and decisions. Mr. Fischer's statement that the history of lease sale #53 reflects "lopsided implementation of the OCS Lands Act" is not supported by facts. As examples, to allow better for State, local and interest group participation in the Call for Nominations and Comment, the normal two- to three-month comment period was extended to seven months. Before tracts were selected for study in an Environmental Statement, meetings were held by Department staff with State and local officials and interested citizens. I met personally with Members of Congress and County Supervisors from California. Also, the period allowed for the preparation of the draft environmental impact statement is about twice the normal period.

A number of points were made by opponents of the sale which are not incorporated in your recommendations.

The problem of severe weather effects on OCS development and production is not unique to the California coast. In fact, weather conditions off California are quite mild when compared to temperatures in Alaskan waters and storms in places such as the North Sea and Gulf of Mexico. In the Gulf of Mexico, the extraordinarily high winds and severe wave action associated with hurricane force storms have caused major damage to oil and gas production platforms and, on a few occasions, have caused the loss of platforms. Even in those instances, no spills have occurred. In all of these regions, oil and gas operations have for years co-existed with fisheries and other resources. It is of interest to note that the only major OCS oil spill in U.S. waters occurred more than 10 years ago and has had no discernible permanent effects. I might add that equipment, knowledge and procedures have drastically improved since the 1969 Santa Barbara incident.

The question of what is required and desirable under the provisions of the Coastal Zone Management Act is complex and not easily resolved. We have not, however, ignored the problems that California has with our actions to date as evidenced by the mediation process currently underway under the leadership of the Department of Commerce. We disagree with California's interpretation of how things should be done, but surely that is a legitimate position to take so long as an amicable solution to the problems is sought.

Local fishing interests have been a special concern of the Committee, as reflected in Title IV of the OCS Lands Act Amendments, the Fishermen's Contingency Fund. The very liberal compensation provisions in Title IV for damage sustained by fishermen are virtually in place. The Department of Commerce is prepared to publish the guiding regulations and the Department of the Interior stands ready to perform its requirements, such as collect fees, notify operators, ensure equipment is properly marked, etc. In addition, the Environmental Statement for sale #53, presently in preparation, will include an extensive discussion of fisheries and the possible effects of oil and gas activities on them.

While fears are often expressed that OCS activities will adversely affect endangered species and areas protected by law or proposed as marine sanctuaries, this has



not happened to date, nor do I intend that it shall. Endangered species are a particular and important consideration for every lease sale. A biological assay of an area proposed for leasing is done by the Fish and Wildlife Service and the National Oceanic and Atmospheric Administration (NOAA) in every instance. These reports concentrate, to a great extent, on the endangered species which may be encountered. As to areas protected by law, there would be nothing allowed which would unduly jeopardize such protection. As to marine sanctuaries, such as those proposed in the Farallon Islands and Monterey Bay areas, we are fully aware of these proposals. We have formally agreed with NOAA to be a participating agency in the preparation of environmental statements on these proposals and are working closely with NOAA and others to assure that there is an environmentally sound and consistent approach to multiple uses of the oceans.

The last item attributed in your letter to opponents of the sale and not covered explicitly in your recommendations deals with aesthetic concerns. I can appreciate these concerns being from an area of the country where broad and uninterrupted natural vistas are common and greatly appreciated. Of necessity, development brings the evidence of man's presence into otherwise natural settings. The problem, and the solution, is to keep this presence at tolerable levels. This would be one of the considerations as final decisions are made on a particular lease sale, after the necessary facts and analyses are available.

In addressing the eight recommendations of the Committee, I agree with your general observation that this lease sale demands especially close scrutiny. I confirm my intention to continue to give especially close scrutiny to sale 53, as I do to all OCS sales. While the problems associated with this sale may be more diverse and, perhaps, even more intractable than those in other places, they must and shall receive all of the attention and time that is needed.

You recommended, first, that the Department proceed with all deliberate speed to complete necessary environmental studies and, in particular, seismic studies. The studies associated with the lease sale, and specifically funded by the Bureau of Land Management (BLM), are designed to fill gaps in knowledge and data. The nature of these studies was determined after extensive consultation, including the interested scientific community of California. One source of misunderstanding is that the contract completion date on some of the eight individual studies invoiced is after the publication date of the draft Environmental Statement. However, in every instance sufficient information and data will be available to write an adequate draft Statement. Every study contract involves the obligation to submit draft reports and preliminary versions of final products well before all contract terms are satisfied. Thus, the information produced by the studies will be available before the final reports are prepared.

As to seismic studies, again there appears to be a misunderstanding. The seismic studies which the U.S. Geological Survey (USGS) is presently conducting for BLM will result in sufficient data to analyze area-wide geologic hazards. Qualified individuals will assess and interpret the data so that sufficient information is available prior to drafting the draft Environmental Statement. Subsequently, even more detailed data will be gathered and analyzed by USGS to serve as the basis for final decisions, on a tract-by-tract basis, as to whether geologic hazards exist on a tract to the extent development cannot proceed safely. Toward the very end of the process, in the final decisions on a proposed sale, all available information is taken into account. For example, for sale 48 I deleted 21 tracts at the time the final Notice of Sale was published, because of geologic hazards. The more general geologic information required in order to write a draft Environmental Statement covering the area of the sale will be available as needed and, as with all information on a subject, is being supplemented by other studies and further analyses.

Second, you recommend that a contingency sale be considered and scheduled in the event that sale #53 is delayed. The sales currently listed on the proposed schedule are designed to account for the resources which shall be available to the Department to prepare for sale decisions. Each sale is, obviously, unique and must be treated as such and there is little effort wholly transferable from one sale to another. To include contingency sales could well result in a waste of resources in preparation for sales which may not be needed or desired. However, we are prepared to consider changes to the proposed schedule which is currently under review.

Third, the areas selected for further study off Northern and Central California have been selected on the basis, in part at least, of high resource potential. Potential environmental problems, fully apparent at the time of tract selection, were also considered. In balancing the views of State, local and environmental officials with energy needs, each of the five areas, and each tract in an area, will be considered

separately. Decisions as to whether to lease, and if so under what constraints, will be made in each case for each tract.

Fourth, a petroleum reserve set aside for a time of "national security emergency" implies that the reserve will be available in a fairly short period of time when called upon. This is the rationale behind the stockpile of critical and strategic materials, a multi-billion dollar inventory of materials maintained by the United States for decades to meet supply interruption emergencies threatening the national security. The strategic petroleum reserve, a more recent creation of the Congress, would result in crude oil immediately available in the vent normal supplies were interrupted. To place undiscovered resources of the OCS in a reserve for national security emergencies could result in not having oil to meet an emergency for many years if at all, since exploration may show there is nothing there. Delays awaiting the outcome of exploration would seem to make such a reserve completely worthless. We will continue to think about this proposal, however, to determine if it has merit not immediately visible.

Fifth, I too endorse efforts, which are environmentally sound, to increase domestic supplies of energy. The efficient use of domestic supplies of oil that become available is also important. Acceleration of onshore production and retrofitting California refineries so that more domestic crude can be processed would help realize these goals. However, it should be made clear that no new energy source, whether it is increased crude oil supplies or some other form of energy, can by itself solve our problems. Onshore energy sources are needed in addition to, not in place of, offshore sources.

Sixth, as regards the West Coast transportation problem, this Administration has given it high priority. I have recently completed my analysis of four proposed systems and recommended to President Carter that the Northern Tier proposal be approved. If Northern Tier can secure the necessary financial backing and throughput agreements, the efficiency of transporting crude from West Coast supply areas to areas of use will be significantly improved. I view the ability of the proposal to obtain private financing as the ultimate test of the system's viability.

Seventh, I have written to the Secretary of Commerce and to the Director of the Office of Management and Budget on funding of the State Participation Grants for OCS activities. I concur with you on the need to fund this program.

Eighth, and finally, you recommend that the Call for Nominations and Comments be restructured to require industry nominations first, with other nominations and comments to follow. This would, of course, lengthen the time required to plan for a sale. The current system provides an opportunity for all interested parties to comment on those areas in the Call in which they have a particular interest. This opportunity is equally, and fairly, extended to all parties, whether they be governmental units, interest groups, industry, or private citizens. The final decision on which tracts will be included in an Environmental Statement analysis is made by the Department and is based on all comment received. In the sale 53 experience, State and local government officials had a number of opportunities to remark on the comments and nominations that had been received, as well as on material USGS and BLM had available in assessing both potential for oil and gas resources and environmental concerns. This simultaneous, open, and quite active procedure appears to result in a desirable level of information availability and position advocacy when decisions are made. Of course, this by no means ends the opportunities for State and local government participation. In fact, it really marks the beginning of a long and productive relationship between the Department and those interested in offshore oil and gas development in a particular area.

This quite lengthy response to your letter is an attempt to place some of the current issues in perspective and clear up misunderstandings. There will never be complete unanimity on any action taken on the OCS, nor should there be if all interested parties are given an opportunity to participate. I do appreciate the assistance we get from the Congress, the States, industry, and the many groups and individuals who participate. While I may not agree with all recommendations and proposals, all are considered before any decisions are made. Please feel assured that the recommendations of the Committee are given special weight and especially close scrutiny. Again, thank you for your letter.

Sincerely,

CECIL D. ANDRUS,  
*Secretary.*

[Whereupon, at 5 p.m., the select committee adjourned.]

# OUTER CONTINENTAL SHELF OVERSIGHT HEARING

MONDAY, SEPTEMBER 17, 1979

HOUSE OF REPRESENTATIVES,  
SELECT COMMITTEE ON THE OUTER CONTINENTAL SHELF,  
*Washington, D.C.*

The select subcommittee met, pursuant to notice, at 9:30 a.m., in room 1334, Longworth House Office Building, Hon. John M. Murphy (chairman) presiding.

Present: Representatives Murphy, Forsythe, Emery, Livingston, and Lewis.

Staff: —.

The CHAIRMAN. The committee will come to order.

Today we will hear testimony from Dr. H. William Menard, Director, U.S. Geological Survey, on the recent announcement concerning the significant hydrocarbon potential of the Atlantic Continental Margin.

On August 30, 1979, the Department of the Interior announced that:

The great oil-bearing reef complex of the Reforma and Campeche Shelf Provinces of Mexico can be traced—with the exception of a few gaps—northward through the Gulf of Mexico and along the Atlantic Continental Margin of the United States, offering an attractive target for testing for oil potential \* \* \*.

It was also indicated that the most attractive area for exploring the hydrocarbon potential of the reef in the U.S. Outer Continental Shelf is in the mid-Atlantic approximately 140 miles off the coast of New Jersey. The mid-Atlantic reef complex alone is estimated to contain 1 to 6 billion barrels of recoverable oil. A potential of 2 to 15 billion barrels of recoverable oil has been estimated for the entire Atlantic reef complex. Describing the oil potential, Dr. Menard is reported to have said, "The best bet is that it could be another Prudhoe Bay."

If this potential proves out, it will be a great boon to our energy supply picture, provided the technology can be mustered to tap that resource. Apparently, the reef complex is under about 6,000 feet of water and another 6,000 feet of sedimentary rock, and will test the limits of our deep sea drilling technology.

Several options have been discussed for exploring the area, including a joint industry/Government project that would involve outfitting the Government-owned *Glomar Explorer* at an estimated expense of \$70 million. The vessel has been proposed by the National Science Foundation to be employed in the "ocean margin drilling" program, and could be a valuable asset for combined science and resource exploration at great depths.

In short, the committee hopes to learn what the prospects are for a significant discovery in this area, what the technological limitations are, what geohazard, environmental and other risks are involved, what exploration strategies are being contemplated, and at what the costs involved are, and finally what is a realistic time frame for leasing and development of the area, should further exploration prove encouraging.

Mr. Forsythe.

Mr. FORSYTHE. Thank you, Mr. Chairman. I thank you for calling these hearings, and I am also very thankful to be able to participate today.

Mr. Chairman, on August 30 of this year, the Department of Interior announced what the newspapers called "an ocean of oil," or another "Prudhoe Bay" offshore New Jersey in the Atlantic.

Since that time I have received numerous conflicting stories as to the potential hydrocarbons in this reef, information questioning if indeed the reef in the Atlantic is identical or even similar in significant degrees to the reef in the Gulf of Mexico; that perhaps the areas of this reef that may be most similar to the area off the New Jersey coast would be Texas, Louisiana, and the Nova Scotia area where there has been numerous drilling with little or absolutely no success; that a *Glomar Explorer* program costing in excess of \$600 or \$700 million for 10 years would be beneficial or at this date even likely for exploration of hydrocarbons.

These and other questions remain to be answered, and I am looking forward to Dr. Menard's clarification of these points.

I thank you very much, Mr. Chairman.

The CHAIRMAN. Mr. Lewis.

Mr. LEWIS. No questions.

The CHAIRMAN. It is OK to drill off that New Jersey coast?

Mr. FORSYTHE. Off Staten Island too.

The CHAIRMAN. Staten Island would be ready, willing and able to take any amount of hydrocarbon that is off that 3-mile limit. They would probably go ahead and exploit it within the 3-mile limit on their own. We had great hearings on lease sale 53 in California, and I think it indicates as I think our major stories over the weekend in the national press indicated the National Sierra Club in particular, and other environmental groups are reevaluating the need for energy as well as the need for environmental concerns. We are getting to the point where perhaps some practical and necessary solutions to this dilemma we face, particularly in this committee, although we have resolved this dilemma in this committee to a certain extent, are before us.

Dr. Menard, it is a pleasure to have you here. I appreciated meeting with you last week, and we look forward to hearing your statement.

#### STATEMENT OF DR. H. WILLIAM MENARD, DIRECTOR, U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

Dr. MENARD. Thank you, Mr. Chairman, gentlemen.

I appreciate the opportunity to come before the Select Committee on the Outer Continental Shelf to discuss a promising area for future petroleum exploration seaward of the Continental Shelf.

Let me say I particularly welcome the opportunity, in order to have the opportunity to lay to rest this statement about the "best bet" being the equivalent of Prudhoe Bay. The question that I was asked in this regard was to the effect of, Is the best possible thing that you believe could happen something like Prudhoe Bay? Since indeed the best possible thing I could think that would happen out there within the range of our resource estimates was something like Prudhoe Bay, I said, yes, but I believe that in common English there is a great difference between saying what is the best possible thing that could happen and what is the best bet. Unfortunately, the best bet is what got in some media stories. However, it is a good bet.

The prospect is an ancient buried reef that lies within the jurisdiction of the United States. It also lies within a water depth range of existing exploratory drilling capability, is testable at a modest cost, is capable of large yields at reasonable prices, and, if it proves to contain oil in commercial quantities, could be produced within a decade, according to our estimates. The prospect may open the door to a much larger area of petroleum potential in greater water depths, and indeed that is a major interest.

All we know now about the reef is that there is a linear accumulation of limestone marginal to the continent in a relationship similar to that between the Great Barrier Reef and the Continent of Australia, a very long linear reef at the edge far from the continents, and at the edge of deep water. Although we have recovered a few samples of coral, we do not know yet whether or not it is composed largely of fossil reef-building organisms, and that knowledge is relevant to the oil potential.

Reefs are regarded as potentially good reservoirs for oil and gas because they may be very porous and they normally grow in proximity to deep basins containing organic-rich sedimentary rocks, suitable for the generation of oil and gas. Giant oil fields associated with reefs have been found in Saudi Arabia, Iran, Canada, and Mexico. For nearly a decade geologists have speculated about the presence of a buried reef off the Atlantic coast.

Following the oil crisis of 1973, the U.S. Geological Survey undertook a systematic, regional geophysical survey of the Continental Shelf as an initial step in an offshore resource assessment program. The geophysical data were used to delineate the major sedimentary basins on the Continental Shelf, but the records also showed an anomalous structure that has the structural characteristics of a reef.

I showed you, Mr. Chairman, some of the types of records we collect, and I believe in the statement you have there are simplified copies of those records, to show you cross sections. Recent evidence from sampling rock exposed on the seafloor on the continental margin—using deep submersibles and the drilling of an off-structure stratigraphic test, COST B-3—Continental Offshore Stratigraphic Test—support this interpretation.

In August of this year, quite independent of the events that eventually led to the presentation to President Carter, I requested our marine geologists and geophysicists to summarize all the recent data and interpretations from the Atlantic margin with the intention of reviewing and modifying, if necessary, the oil and gas

resource estimates of the Atlantic Outer Continental Shelf. During this conference, it was evident that the reef is indeed an attractive prospect and that it could contribute to easing, but certainly not solving, the problem of making the transition to new energy solutions.

Ultimately we know we will run out of oil and gas, but the more we can find meanwhile the easier it will be to make the transition to other sources of energy. Accordingly, Dr. Frank Press, Presidential Science Adviser, and I concluded that it was worthy of presentation at the Presidential Energy Technology Seminar that was held in Atlanta on August 28 and 29.

I would like to emphasize that the seminar was on technology. What we were doing in our conference at Woods Hole was to try to have the various groups in the Geological Survey reevaluate their evidence simultaneously and see if the sum of the knowledge of people from Denver and Menlo Park, Woods Hole and Reston was more than the separate components considered separately, but because this was a technology seminar, it seemed particularly timely to consider the reef that we were analyzing at Woods Hole.

We do not believe that this reef is the best possible place to find oil and gas within the jurisdiction of the United States. What we believe about this reef, and why it was pertinent for this seminar, is that it offers us a promising opportunity with large potential resources to open up our expansion of U.S. development of the oil and gas resources of the deepsea floor. That was our purpose.

Let me point out at this time the illustrations we have here, only some of the number you have. Do the gentlemen all have copies of our statement?

The CHAIRMAN. Yes.

Dr. MENARD. Your blackboard was not big enough to put up all of these things. Let me refer you to the first of these showing the Jurassic-Cretaceous reef trend. Jurassic-Cretaceous refers to rocks deposited at a time there were dinosaurs or approximately 100 to 140 million years ago. An intermittent reef, as you can see, has been traced from Mexico around through Texas, out to sea in Louisiana and along almost the entire east coast of the United States, disappearing off this map into Canada.

To show you an example of the extent of our coverage, we have this presentation. This is part of the systematic survey that the Geological Survey began in 1973. All these long lines are part of, as you can see, the relatively even spaced regional survey trying to determine the thick sediment and promising basins to be considered for future leasing, but the information accumulates all the time. In some places especially for shallow water hazards we have 10 to 100 times as much information.

Just as an illustration how we get new data all the time, and the data gets better and better, and that there is international cooperation in this sort of business, the three lines here and the three lines here, Dr. Edgar informs me, were just collected by a German ship using their latest technology which is very similar to ours. Inevitably we will know more about this area than we did before because of something new coming in.

During the last year we collected data down here primarily for deep evaluation of the oil and gas potential. All through here we

have been collecting information on shallow hazards, and that continues.

This is the Baltimore Canyon Area. Here is Atlantic City, and here again is Atlantic City as we go over to this larger scale map, and you can see the lease area off Atlantic City. These are depth contours, 200, 1,000, 1,500, 2,000 meters, so this is something over 6,000 feet deep, and the yellow is where in our subbottom profile I think we are able to identify what we interpret as a reef structure, and which in some places have been sampled and found to be reef materials.

This is about 150 miles. The reef itself, this is just the crest of the reef, the reef itself is about 15 miles wide. I cannot show you line 25, but we will look in the figures you have and you will see it. COST B-2 hole, one of the test holes is here. COST B-3 is here, very close to the reef, and it is particularly interesting because it has gas in it.

The characteristic of these COST holes, although it changes as the regulations change, has been that industry could be authorized to drill them only where there was no expectation on their part or on our part that they would encounter oil or gas. That is, the COST holes are drilled where everyone agrees, with any knowledge on the matter, it is the best possible place not to find oil or gas, and yet even so, interbedded with the limestone of the reef are sands, and those sands had gas in them, not commercial gas by any means, but the fact that there is gas at all is significant.

Tenneco and Texaco drilling was up here; the blue is the initial lease sale; the green is the one we just held. This green boundary out here is the one that will be held in December of 1981.

Texaco and Tenneco have found gas in two holes drilled here. This is the famous Great Stone Dome, which is apparently a large intruded igneous mass with sediment domed over it, and this looked like the best possible prospect for drilling, and it is where the greatest amount of money was bid. The first lease was held here [indicating].

So far there are five holes that are dry, and one hole that is still drilling. Well, that tells us two very important things. One is that the best people in industry did not guess right this time, and if the best people in industry do not guess right, I do not think I am so vain or you would believe me if I told you that the best people in the Geological Survey always guess right.

Even when you have all the information and you have to put tens of millions of dollars on the line for the right to drill, you can still be wrong.

The other things it tells us is that even though five holes have showed that industry is wrong, they are still drilling one more hole, so it takes a lot of holes before you can be sure that it is not a good prospect.

Could I ask you to look at your figure 5 in the text? It shows USGS line 25 and it fudges a little. We do not know a great deal right along this line, so we sort of pretended that this COST hole was on the line, and that the Tenneco holes in the Great Stone Dome are on various lines in here.

If you look at this figure 5, you see a not very imaginative copy; that is, it is a copy that anyone reasonable would make from the record, because the records we have now are very, very good.

The reason they are very, very good is why these profiling records enabled us to see what the rocks are like tens of thousands of feet down under the seafloor. They do not show the age of rocks; you have to sample to get that. But they trace various levels of the rock strata horizons, so that if you can just date them in one place you can get the ages all over, and that has been done in many places. We see here, then, a cross section of the seafloor with another interpretation that is very close to what is actually down there.

I have to emphasize that as time goes on, these records get better and better. This one is done by processing the information with a computer. It isn't what comes out of even the best equipment to begin with. It is what happens after you have manipulated it.

We see in this profile, as I said, the COST 3 hole projected in. You can see the reef core with the limestone in it just coming out to where the B-3 hole is, and interbedded material from the left side, which is toward the continent, which is the Jurassic rock including the sandstones that bear the gas.

We see also on this profile the backreef and the forereef. We have not attempted to say much about those in our evaluation, because we do not really know all that much about them. We can just see them on the profiles, and we have a little information on the COST hole. What you get down to when you have not drilled the place, is comparing what is found elsewhere in similar geological environments. Elsewhere in the world there are large oil fields associated with the forereef, the reef core, and the backreef. All of them are possible prospects.

We see also in this profile some drilling rigs with below them 4,800 feet, 6,000 and 7,200. This was redrawn from the original color diagram that was made at Woods Hole by our oceanographic people. When they did it they had drilling ships up there—"they" being oceanographic types—but when it was simplified to present here in just black and white, somehow or other the ship disappeared.

We do not really believe you can put a drilling rig out there, but there is a drilling ship operating in 4,800 feet water depth off Canada right now. That ship is designed to operate at 6,000 feet, and we are told that with modest modification it is capable of going to 7,500, and that is why those rigs are drawn in there.

Now this reef occurs at shallower depth than 6,000 feet. It occurs in some places as shallow as 2,000 feet. The emphasis we have been making on this particular area is because we have such a large amount of sedimentary rock, potential source rock, to feed the reef, and also because of course we were talking about high technology, and the possibilities for the future.

The best place combining the existing technology and the potential for large accumulations of oil is in this region, the Baltimore Canyon region we have been talking about, but the reef does occur in shallower places. Indeed, it crops out at a place where a submarine canyon cuts into it, but there you can only get a small fragment which you can reach out from a diving saucer.



We have here figure 4, which is more elaborate. Would you care to have me discuss that, Mr. Chairman? It begins to get a bit more geological and I do not want to take the committee's time expounding on lessons in geology.

The CHAIRMAN. I think we can bypass that.

Dr. MENARD. Fine.

Now, if I can continue briefly before completing my initial statement, exploration of the deep U.S. Continental Margin has been directed toward scientific objectives, and thus the data are not always adequate for the purposes of resource assessment. That is not so true for this particular region, but it is for the parts of the Gulf of Mexico and the area between the Gulf of Mexico and here.

However, it appears that the buried Atlantic reef can be traced intermittently through the northern Gulf of Mexico, to the great petroliferous reef complex of the Golden Lane and possibly even the Reforma and Campeche Shelf provinces of Mexico. As I said, it occurs in depths of 2,000 to 6,000 feet. The thickness varies, but in general it is about 6,000 feet of sedimentary rocks. The reef is roughly 10,000 to 20,000 feet thick and 15 miles wide, bordered by thick layers of potential source rocks and appears to have a suitable seal above it.

I think having summarized how we collected the information in some of the following material, Mr. Chairman, I would prefer to ask you to ask questions at this point.

[The statement follows:]

PREPARED STATEMENT OF H. WILLIAM MENARD, DIRECTOR, U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

Good morning. I am H. William Menard, Director of the U.S. Geological Survey. I appreciate the opportunity to come before the Select Committee on the Outer Continental Shelf to discuss a promising area for future petroleum exploration seaward of the Continental Shelf.

The prospect is an ancient buried reef that lies within the jurisdiction of the United States. It also lies within a water depth range of existing exploratory drilling capability, is testable at a modest cost, is capable of large yields at reasonable prices, and, if it proves to contain oil in commercial quantities, could be produced within a decade. The prospect may open the door to a much larger area of petroleum potential in greater water depths.

All we know now about the reef is that there is a linear accumulation of limestone marginal to the continent in a relationship similar to that between the Great Barrier Reef and the continent of Australia. Although we have recovered a few samples of coral, we do not know yet whether or not it is composed largely of fossil reef-building organisms, and that knowledge is relevant to the oil potential.

Reefs are regarded as potentially good reservoirs for oil and gas because they may be very porous and they normally grow in proximity to deep basins containing organic-rich sedimentary rocks, suitable for the generation of oil and gas. Giant oil fields associated with reefs have been found in Saudi Arabia, Iran, Canada, and Mexico. For nearly a decade geologists have speculated about the presence of a buried reef off the Atlantic Coast. Following the oil crisis of 1973, the U.S. Geological Survey undertook a systematic, regional, geophysical survey of the Continental Shelf as an initial step in an offshore resource assessment program. The geophysical data were used to delineate the major sedimentary basins on the Continental Shelf, but the records also show an anomalous structure that has the structural characteristics of a reef. Recent evidence from sampling rock exposed on the seafloor on the Continental Margin—using deep submersibles and the drilling of an off-structure stratigraphic test, COST B-3 (Continental Offshore Stratigraphic Test)—support this interpretation.

In August of this year, quite independent of the events that eventually lead to the presentation to President Carter, I requested our marine geologists and geophysicists to summarize all the recent data and interpretations from the Atlantic margin with the intention of reviewing and modifying, if necessary, the oil and gas resource

estimates of the Atlantic Outer Continental Shelf. During this conference, it was evident that the reef is indeed an attractive prospect, and that it could contribute to easing, but certainly not solving, the problem of making the transition to new energy solutions. Accordingly, Dr. Frank Press, Presidential Science Advisor, and I concluded that it was worthy of presentation at the Presidential Energy Technology Seminar that was held in Atlanta on August 28 and 29.

Exploration of the deep U.S. Continental Margin has been directed toward scientific objectives, and thus the data are not always adequate for the purposes of resource assessment. However, it appears that the buried Atlantic reef can be traced intermittently through the northern Gulf of Mexico, to the great petroliferous reef complex of the Golden Lane and possibly even the Reforma and Campeche shelf provinces of Mexico (Fig. 1). On the basis of our geophysical traverses, this 100,000,000 to 140,000,000 year old reef is almost continuous along the Atlantic Margin from Maine to Florida (Fig. 2). It occurs in water depths ranging from about 2,000 to 6,000 feet and is covered by another 6,000 feet of sedimentary rocks. The reef is roughly 10,000 to 20,000 feet thick and 15 miles wide, it is bordered by thick layers of potential source rocks, and appears to have a suitable seal above it. It is developed best along the seaward edge of the Baltimore Canyon Trough and, in fact, forms the eastern edge of the basin (Fig. 3 and 4).

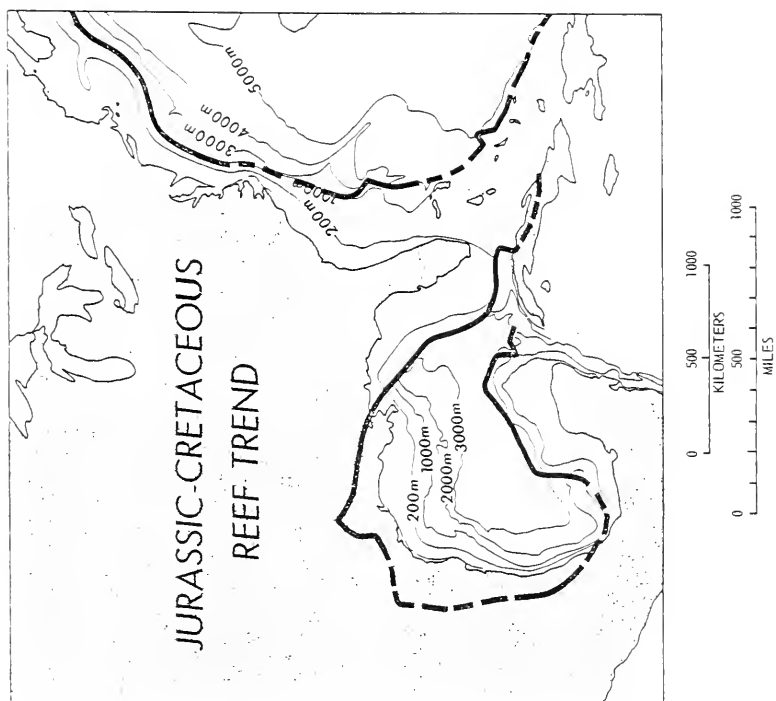


Figure 1

# JURASSIC/CRETACEOUS REEF TREND

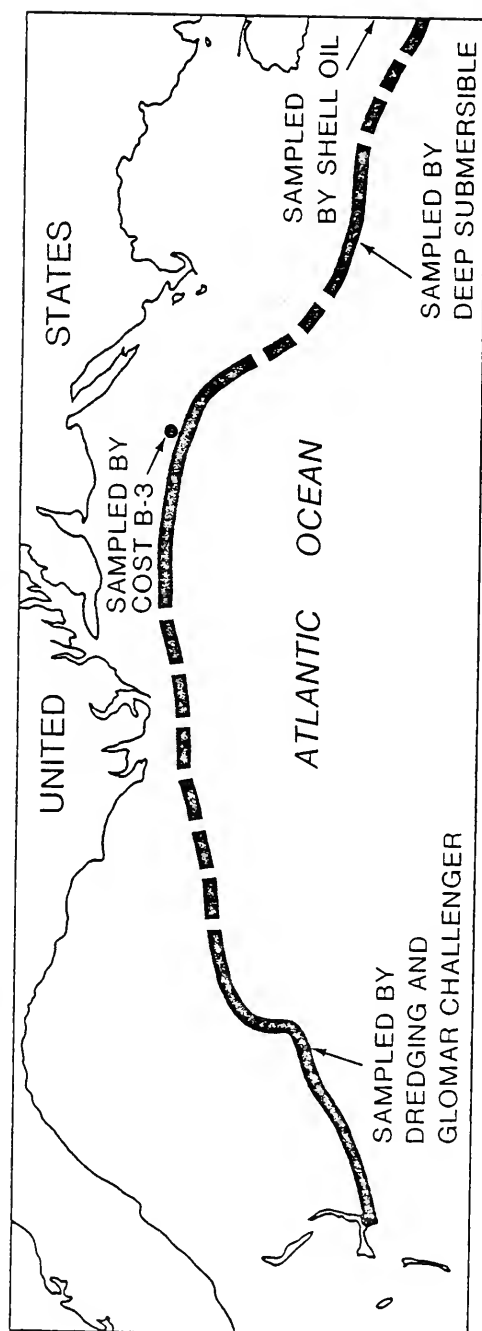


Figure 2

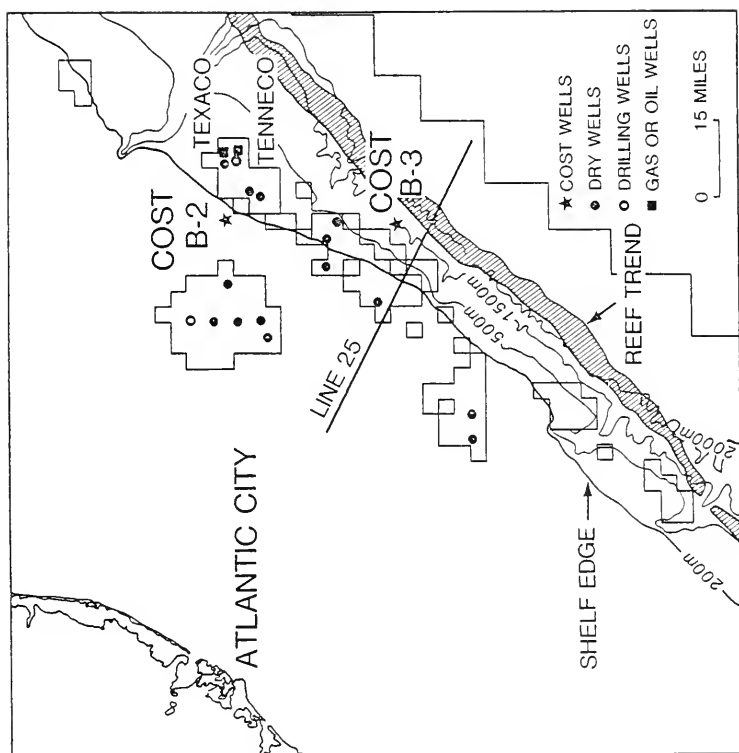


Figure 3

## BALTIMORE CANYON TROUGH

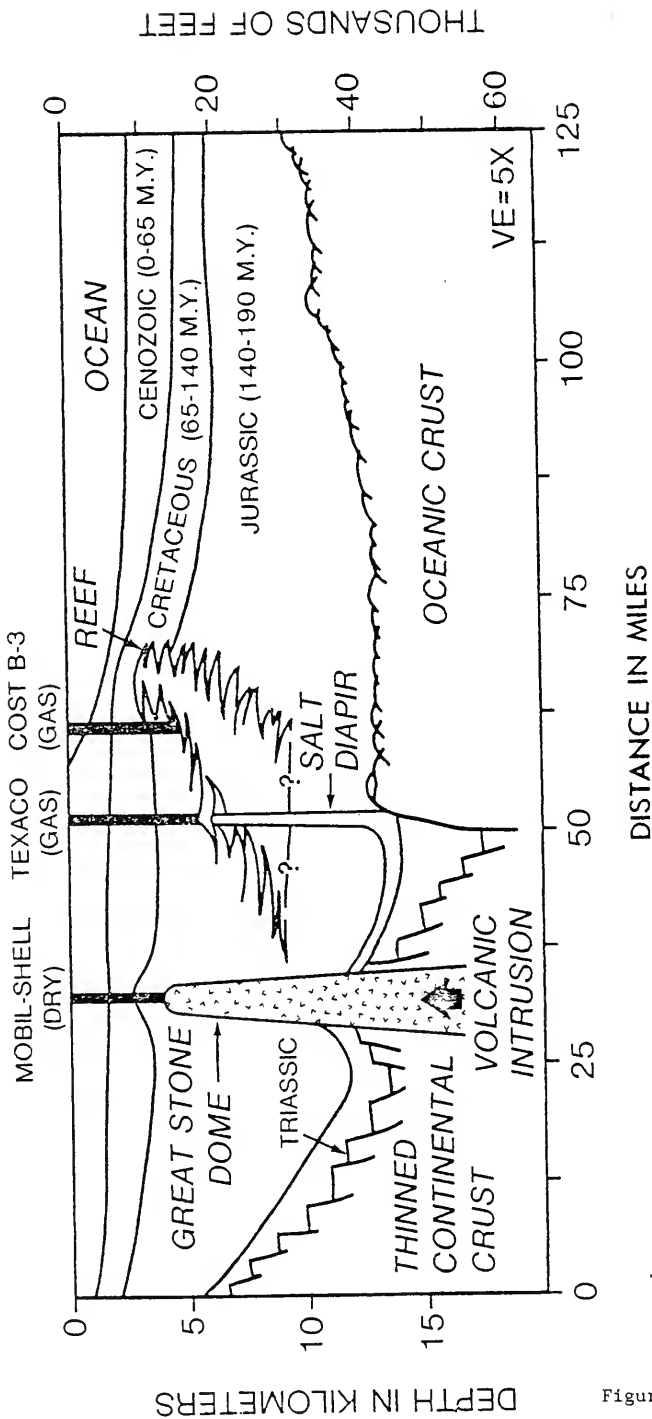


Figure 4

# USGS LINE 25 - CONTINENTAL SLOPE OFF NEW JERSEY

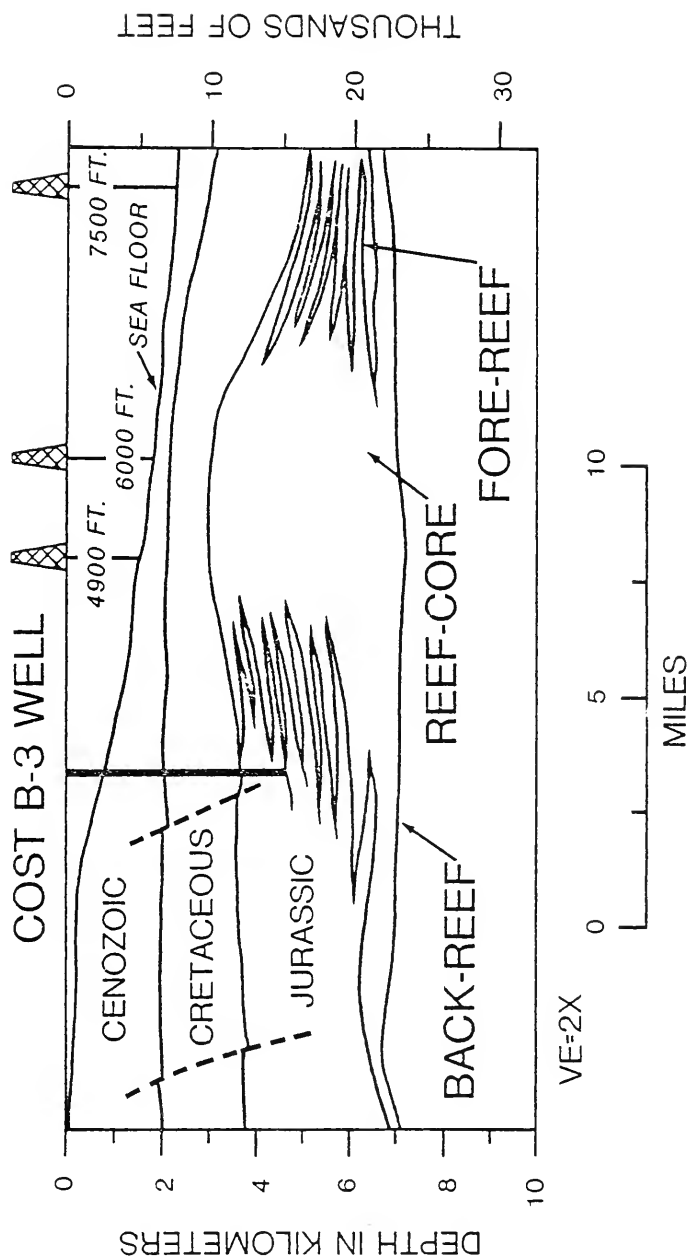


Figure 5

Seaward of the reef is a large deposit of thick sediments that also appear to be oil prospective, but they are deeper and, as with similar deep water sediment in the Gulf of Mexico, are still out of technologic and economic reach.

Our concept of the reef in the Baltimore Canyon Trough area is shown in Figure 5. The core of the reef is limestone, possibly formed by the skeletons of growing fauna and flora or alternatively composed of carbonate sands. The fore-reef area may be characterized by coarse reefal debris that has broken off the core and fallen into deeper water. The distal ends of the fore-reef interfinger with the basin rocks that may be source rocks for petroleum. The back-reef rocks are probably limestones that grade into sands and muds derived from the land. Much of the Baltimore Canyon Trough is filled with these kinds of sands and muds. The COST B-3 well encountered limestones with interbedded sands containing gas. We would interpret these limestones to be back-reef rocks. Figure 5 also demonstrates the water depth drilling capability required to reach the various parts of the reef in this locality. In some areas, the core of the reef lies below only about 2,000 feet of water.

Concurrent with the oil and gas resource search, the USGS is engaged in a program of identifying and evaluating geologic features that may pose a hazard to exploration and, particularly, to production facilities on the seafloor. Because of the relatively steep slope seaward of the shelf, and the thick sediments, there is a tendency for large blocks of sediment to slide or slump downslope. Twenty-seven lease tracts were deleted from the Lease Sale No. 49 because sediment movement was evident. Further studies on these features are being conducted to better understand the conditions of sediment stability in this area. Also, we are currently mapping similar features in deep water seaward of the Sale 49 area, and are engaging in a program to determine when these slumps moved, if they are still active, how fast they might move, and if they might move again. There are also some regions that appear to have indications of incipient movement. On the basis of our research thus far, we can locate broad areas of the seafloor above the reef that exhibit no signs of seafloor instability.

The U.S. Geological Survey has evaluated the petroleum potential of the reef complex. Estimates of resources in undrilled regions are made by comparing the geology and the geologic history with those of similar regions that have been drilled. The porosity and permeability of a reef may vary greatly, so not all reefs make good reservoirs. Those that have been raised above sea level, prior to final burial, and exposed to the leaching action of fresh water exhibit greatly enhanced reservoir characteristics. Estimation of the chances of porosity enhancement is critical in the resource assessment. For this purpose, we compared the Atlantic reef system with Texas back-reef production reflecting those limestones that had not undergone porosity enhancement, and also with the highly productive Mexican reefs and the reefs of the Permian Basin of west Texas where the leaching action of the fresh water has suitably enhanced the porosity. By using such analog techniques, the U.S. Geological Survey has estimated that the reef complex of the mid-Atlantic lease area may contain 1 to 6 billion barrels of recoverable oil and the entire Atlantic reef trend may contain 2 to 15 billion barrels of oil. In both cases, an assessment assumes that oil is present. If the amount of organic material in the source rocks is inadequate, or of the wrong type, or was never exposed to sufficiently high temperatures, there may be no oil at all. There are many other factors that bear on whether or not oil will be preserved in the rocks, but to discuss them all would be beyond the scope of this presentation today.

Advances in deep water exploratory drilling technology have been dramatic over the past 6 years. By 1973, the deepest water in which an exploratory well had been drilled was 1,497 feet (1970). In 1979, the record reached 4,876 feet. A technological breakthrough enabled the drilling vessels to maintain station without employing mooring lines; new, dynamically positioned vessels using powerful thrusters responding to seafloor-mounted beacons, can position virtually anywhere in the oceans. Currently these vessels are limited in their drilling capability to even greater water depths by inadequate lifting power (to handle the weight of riser and blow-out preventer), limited storage space for risers, and lack of riser and blow-out preventers designed for water depths greater than approximately 6,000 feet.

If existing rigs are available, and suitable drill sites can be found, the prospect could be tested within 12-19 months at a cost of approximately \$12 to \$15 million per well. A testing program could be volunteered by oil companies as part of the Continental Offshore Stratigraphic Test consortium, but on-structure drilling would be required. The Outer Continental Shelf Lands Act Amendment of 1978 gives the authority to the Secretary of the Interior to authorize on structure stratigraphic drilling. At the other extreme, the government could carry out exploration, prelimi-



nary to leasing, as we are doing in the National Petroleum Reserve in Alaska (NPRA) program.

Commercial production of oil and gas is limited to water depths of about 1,000 feet. The Shell Cognac platform was installed in the Gulf of Mexico in 1,025 feet of water. This is the deepest installation to date. Industry has turned to other designs for production systems for water depths greater than 1,000 feet. Data collected for a 1/2th scale guy-tower system by Exxon demonstrated the feasibility and practicality of operations in water depths up to 2,000 feet. Moored platforms, both tension-leg and vertically moored, have been considered for drilling and/or production platforms. For example, Sedco-Hamilton is using a moored semisubmersible as a production platform in the North Sea. Subsea production systems have been developed by several companies; two types have been built and tested—a wet system exposed to the sea water by Exxon, and a dry system enclosed in atmospheric pressure chambers by Lockheed Petroleum Services. The Exxon system is designed to operate in 5,000 feet of water, and with minor modification, the concept could be employed in much deeper water. We estimate that production could begin in water depths of up to 5,000 feet in 8 to 9 years, if exploratory testing shows the presence of recoverable petroleum.

The Bureau of Land Management, Department of Interior, has extended the area boundary on the Call for Nominations in the forthcoming Sale 59 to include the reef complex. The maximum water depth in this call area is about 8,000 feet. It is unknown at this time whether industry will nominate tracts over the reef in view of the high cost of exploration and development in significantly deeper water. The Department may exercise its option to extend the lease period, use a different leasing system, or enlarge the size of the lease tract (currently 3 miles by 3 miles). No change the proposed lease schedule for the next 5 years (through 1985) is recommended.

Based on available information, we do not envision any significant differences in the environment impacts of deep versus shallow-water exploratory drilling or production.

Respected petroleum geologists have indicated the great oil potential of the deep water areas of our continental margins. It has been my intent today to demonstrate that reasonable prospects lie within current drilling technology and a potential for future petroleum resource lies in deeper water beyond our present capability.

The CHAIRMAN. Thank you, Dr. Menard. We appreciate your very forthright and interesting statement and evaluation.

Tenneco geologists in a Washington Post news story back after the initial lease sale in this area had indicated that they felt the potentials were in much deeper water and farther out off the shelf, in areas that had not been offered in that first lease sale, and that the original assessment of the potential, even though there was I think considerably high money interest by major oil companies, that that assessment was that the high potential was out farther; and you had stated in this statement that you've known for a long time of the presence of this reef, and the geological information you just gave us. Why were the initial sales not included over this particular area?

Dr. MENARD. I entered into the Department of the Interior's proceedings on these sales after the initial sale, but judging by all the ones that I have attended since, in which the Secretary reaches or is given the information on which he reaches a decision on what to lease, it is judged that there is only a limited amount of seafloor that can be developed by industry at a given time, and so one sets up a lease schedule leasing something on the order of 600,000 to 1 million acres per sale.

Certainly one could lease larger areas, but the initial sale would have been far larger than any other that has been held as far as I know, had it gone all the way out into deep water.

Also, it costs more money to deal in deep water, and while one can in retrospect say that the oil potential looks much better out

farther, the larger bids were on the Great Stone Dome, which is in close, where nothing has been hit. The smaller bids, meaning that the consensus in industry was that they weren't quite so promising, was in the area where the Tenneco and Texaco wells are, and from that I would say that once again hindsight is easier than foresight.

The CHAIRMAN. The delay in nominations for 59 amounts to how much time?

Dr. MENARD. I believe it is 2 weeks. It is certainly within the same month. I have that, sir, somewhere. Could I add that to the record? It is about two weeks.

The CHAIRMAN. Yes. I think we will also put Secretary Andrus' press release of September 5 in the record on the delay on that sale.

[The information follows:]

**DEPARTMENT of the INTERIOR**news release

BUREAU OF LAND MANAGEMENT

Robinson (202) 343-5717

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For Release September 5, 1979OCS SALE #59 CALL AREA IS EXTENDED

In keeping with President Carter's directive to expand opportunities for petroleum recovery on the Outer Continental Shelf, Secretary of the Interior Cecil D. Andrus today announced an extension of time and territory for a proposed OCS oil and gas lease sale in the Mid-Atlantic.

Andrus said that in the Call for Nomination and Comments for proposed OCS Sale #59, he was extending the deadline from September 7 to September 28, 1979, and including more marine bottomlands because of recent information received from the Geological Survey.

His decision was based on a U.S. Geological Survey announcement that an oil-bearing reef complex in the Gulf of Mexico extends along the Atlantic continental margin, with the best oil potential in the Mid-Atlantic area proposed for leasing. The USGS said this area may contain from 1 to 6 billion barrels of recoverable oil, and the entire Atlantic reef trend may hold 2 to 15 billion barrels.

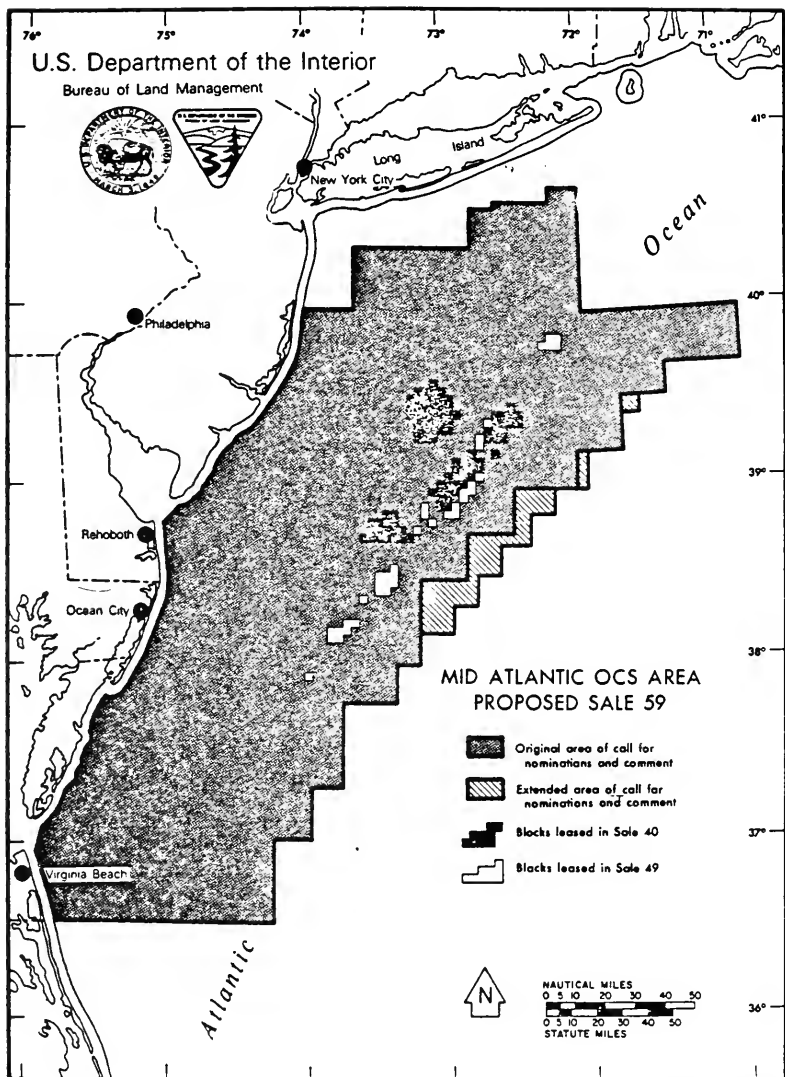
The new Call area will be 25 miles farther seaward in the area offshore New York New Jersey, Delaware, Maryland, Virginia, and North Carolina. A total of 92 added tracts comprising 523,773 acres (211,968 hectares) will extend the area to include a reef on the edge of the Continental Shelf in water depths up to 8,827 feet (2,675 meters) deep.

The new total area of the Call will be 3,513 tracts comprising 20.5 million acres (8.1 million hectares). The seaward range of the new total Call area will be 170 statute miles. OCS Sale #59 is tentatively proposed for December 1981.

This amended Call for Nominations and Comments area is being published in the September 5, 1979, Federal Register.

A map showing the blocks leased in two previous Mid-Atlantic sales and the new Call area is attached.

\* \* \*



The CHAIRMAN. Is 2 weeks enough time for industry to evaluate further this area, after the information that came out of your and Dr. Press' statements of several weeks ago?

Dr. MENARD. I would think that if industry had to examine the whole reef from scratch, that that would be quite unrealistic, but I do not believe that is the circumstance, Mr. Chairman.

If I can return to the map for just a second, you can see that the logical way to offer the tracts for lease is to offer them depth by depth, according to the increasing costs of production, and because of the limits on technology. And so a line was drawn sort of parallel to the continental slope here, by the Bureau of Land Management, to set the limits of the next sale, but it is difficult to describe a line that runs diagonally across latitude and longitude, so they simply set up a rectangular grid instead that went more or less like this, quite a logical procedure if you had nothing else to consider.

It is easy to describe, and it more or less follows the diagonal, so that part of this reef was available in the initial announcement. In fact, just alternate patches of it were available.

It seemed, considering the trend, and that there was no compelling logic for having large zigs, to ask BLM to make small zigs, which they did. So I find it difficult to believe that the oil companies would have acquired the information for the alternate patches and not have filled it in. That is not a sensible way to do exploration, so I imagine they had the information.

The CHAIRMAN. We had problems of some areas being withdrawn because of mud slides. Would there be any mud slide problem in the areas that we have discussed here this morning?

Dr. MENARD. Yes; there probably would. It is after all, the Continental Slope. It is steeper than the Continental Shelf, if you look at the vertical exaggerations we put in diagrams, always looks like you could not walk it with climbing boots and picks, but in fact you could put a railroad up most of it. It is sort of a 1-degree slope. I think you can put a railroad on that, certainly a highway. It isn't all that steep.

Nonetheless, there is unconsolidated sediment piled on it, and we know that very large slumps have occurred in places on this slope in historic times (1929 off Canada, for example), but our estimate is that in the area of this reef, about 85 percent of the seafloor is suitable for safe drilling.

The CHAIRMAN. In the Mississippi Delta we have had testimony that millions of tons of mud are cascading constantly off that slope, and still people are drilling in that area, and conquering the engineering problem. Would the slides here present a greater risk than they do in the Gulf in that area, or I think perhaps less of a risk?

Dr. MENARD. I would think certainly less of a risk, because the likelihood of a slump depends on the rate of accumulation of the sediment, whether it can get rid of the water, and so on. The Mississippi is about the most unstable place you can think of on that score. The profiles of bottom are just covered with landslide scars, and of course we have very deep development on that delta, submarine delta, of the Mississippi River.

But to say that 85 percent of the region can be developed means that even at present, with the information we have, and we also

play it very conservatively, it is our responsibility in the Geological Survey to protect the environment as well as open up areas for potential resource development, if we say at this point that 15 percent of it does not look like you can drill, that is not very much.

Any given tract 3 miles on a side that has any place in it where you can put a platform, we will allow drilling, with the stipulation that you have to put it where we do not see any problem with instability. So to sort of spread it around, if you say that every 3-mile square tract had 15 percent where you could not drill, and 85 percent where you could, all of it could be developed.

The CHAIRMAN. That really is not a specious argument then, to prevent drilling, or to stop drilling.

Dr. MENARD. One would not expect that you could not drill because of instabilities in this deeper water. On the upper continental slope, I would say we are kind of at the limits of our understanding of what is going on. The NOAA scientists have reported a large slump in this area on the uppermost continental slope.

Our own records show a peculiar configuration of the subbottom which may be a large slump, but this is part of my own expertise as a marine geologist for the last three decades, and I looked at the records we have, not all of them, but I went over the records with our experts at Woods Hole because I was interested in what they had, and they were sort of interested in having an old man like me in the business look at things, and it was clear that what has occurred off there has not been described in the scientific literature in a way that you really can understand. It kind of looks like the Dakota badlands, and it is difficult to see what happened.

We are collecting information all the time and the evaluation is going on. Their present thinking is that some of the features that look like very large slumps may have been active tens of thousands of years ago, but they do not see any evidence that they are now. Now, the NOAA scientists thought that in the area where they inspected the slumps were active, but the only way we can be sure that they are active is to drill through that apparent scar at the bottom of the landslide, and that has not been done. You have to go down about 1,000 feet and it is just in the sort of wrong range for technology.

Oceanographers cannot get down that far and the oil companies have not had occasion to drill, so until we can carry out a research project, which we are beginning, we won't really know whether they are active.

The CHAIRMAN. The USGS has indicated that tests of the oil prospects of deeper parts of the reef could be initiated in 1982 and 1984. You stated the technology is there to go 5,000 feet today. Why do we talk about the 1982 to 1984 range, or are we talking about deeper ocean drilling?

Dr. MENARD. There are two things that I talked about in the energy technology meeting in Atlanta that might cause some confusion. One of these is that industry now has, as that diagram showed, a potential.

You can lease a ship this very moment, as far as I know, if you have the desire and the money, to drill this reef. It has blowout preventers and so on, a commercial rig. One could, in short, getting

appropriate permission, and with the desire of industry to drill through the COST hole program on or off structure, industry could drill that reef.

That, I would say, could be done in a time scale of about 1 year. That is, it does not take very long to get permission. It would appear safe, and the drilling itself would not take more than that.

The 1982-84 range is the time that it would take to convert the *Glomar* to make it capable of doing this drilling.

The CHAIRMAN. For \$70 million?

Dr. MENARD. For \$70 million, yes, that is right.

The CHAIRMAN. Where would that money come from?

Dr. MENARD. I certainly did not address that question in Atlanta. It would not come from the Geological Survey, because we do not have that sort of money. There is a proposal by a consortium of university and government scientists, largely university initially, to carry out an exploration of the continental margins with a ship that can drill in these thick sediments. The present ship, the *Glomar Challenger*, cannot drill anywhere where there is oil and gas because it does not have blowout preventers, and it cannot be modified to drill in very deep water with blowout preventers.

The scientists have banded together and come up with a project which could begin somewhere in the 1982 to 1984 range, depending on how deep you wanted the blowout preventer capability, at a cost of \$70 million to outfit the *Glomar Explorer*, the former CIA spy ship, to outfit it so it could do this drilling—it is lying idle in Long Beach right now—and then carry on a program for several years certainly, having gone to that expense for quite a while probably, to explore the continental margins in advance of the capability of industry. There is no use using the *Glomar Explorer* drill where you can hire a drill ship right now. It would be much cheaper to hire the drill ship.

The CHAIRMAN. Has private industry shown interest in participating in that program?

Dr. MENARD. I have heard from industry and from people in the government that there are conferences going on. I have not participated in the conferences, so as far as I am concerned it is hearsay. I think so.

The CHAIRMAN. I have other questions that are pretty technical and technological in their impact, and I will give you those for response for the record, and ask you to respond to them.

Dr. MENARD. Of course.

The CHAIRMAN. Mr. Forsythe.

Mr. FORSYTHE. Thank you, Mr. Chairman.

Good to see you, Dr. Menard. Since we are having a lease sale in December of 1981 and November 1983, why is it so crucial to refit the *Glomar* for hydrocarbon research when it will not be ready to drill until late 1983 or early 1984?

Dr. MENARD. These are disconnected activities. One is directed from within the continent by the drive of the United States to acquire oil and gas reserves. The other is directed from the deep sea by the oceanographers who are trying to acquire information which will be used sooner or later, one hopes, for that purpose. But

the *Glomar Explorer* is from the deep sea toward the continent scientific approach.

Mr. FORSYTHE. Are you saying that it really will not be developing exploring specifically for oil or gas at these depths, but that during the scientific research program it could lead to further exploration?

Dr. MENARD. Yes, sir.

Mr. FORSYTHE. Is that it generally?

Dr. MENARD. The reason I combined the *Glomar Explorer* when I mentioned this fact in a couple of sentences in Atlanta was that industry's capabilities are sensibly going to be developed, only slowly, as they move out into deep water. It does not make economic sense, at least to a nonindustry man, to do it other ways, but coming in the deep sea with the *Glomar Explorer*, you could explore this reef at its full length. You could explore the Gulf of Mexico where its promise in the deep sea is viewed by some eminent petroleum geologists as even better than the reef, but that is at 12,000 feet. It is way beyond industry.

Mr. FORSYTHE. Isn't there another problem—and again it is really critical in your expertise—is it your information that we could explore at these depths, but development is another matter, and as it now stands, we are probably somewhere over 3,000 feet short of getting down to that 6,000-foot depth so far as actual development, once we do find it. Is that statement true?

Dr. MENARD. Yes, it is certainly correct that there is no production much below 1,000 feet at present, but there is equipment—we are not in my expertise but I did draw upon our experts, and they inform me that an essentially ambient pressure bottom operating type of equipment developed by Exxon was designed to operate out to 5,000 feet. It has never been tested at that depth.

There is, after all, not even exploratory drilling out to that. There are other types of equipment which can operate well below 1,000, and in fact there are some designed to 2,000, so we are beyond the present capability of industry to produce.

Mr. FORSYTHE. Also I suppose it is true that exploration that would prove the availability of resources would be a pretty good incentive to get production equipment going?

Dr. MENARD. Yes, that certainly was in my mind.

Mr. FORSYTHE. In lease sale 49, the work required by Public Law 95-372 has been completed. Couldn't we revise the EIS and bring the 22 tracts that were pulled from sale 49 up for sale in 1980?

Dr. MENARD. I wondered when looking at the data with my young colleagues at Woods Hole whether they had not gone a bit overboard in assessing the risk of slumps and slides in the area, and excluded some of the most promising locations. It may be that when we have completed the work that we now have underway, which I think will take about a year, perhaps longer if we have to drill as we may have to, that we might be able to reevaluate those tracts, but at present the only conservative thing to say is that we do not know, and so until we have finished the research, we could offer encouragement to people, but I do not think it would be safe.

Mr. FORSYTHE. So you are still saying we will have to wait until what is it? 81 or 83, so far as those 22 tracts are concerned in that lease sale?



Dr. MENARD. I would hope by that time, certainly by 1983-84 we would have completed a reevaluation, and we will have a lot more information. I am kind of optimistic that it won't turn out to be as prone to slumps as we presently think.

Mr. FORSYTHE. Really your primary testimony today is dealing with this reef. There is a great many questions remaining to be answered pertaining to the evaluation of information we have, before we can determine what would be beneficial. As examples, can we determine there are any closures? Aren't there breaks in the reef and very significant breaks in our information as to where this reef is continuous or not?

Dr. MENARD. Yes, that is one reason that scientists, including from Germany, keep on collecting more information. There are places where we know the reef is not continuous. There are places where it is thicker and there are places where it is thinner, but that it characteristic of reefs. The Great Barrier Reef is the same way. The most important question probably is whether or not the reef was ever elevated above sea level, and thereby exposed to erosion which would produce the kinds of cavernous weathering that is so desirable for rapid production of oil—if you have oil there as opposed to the other possibilities, namely, that the reef has had calcium carbonate bearing groundwaters going through it and sealing up all the pores. Either of those is possible. One place if you have got oil all around it, the reef turns into a gold mine, and the other thing it just turns into a barrier to flow.

Mr. FORSYTHE. Isn't it true—that the geography in the Campeche Bay is different from offshore New Jersey, and isn't it also true that the reef is not identical since it is Jurassic everywhere except in the Bay of Campeche where it is Cretaceous? Now your maps, figure 4 and figure 5, I suppose say something different, but we have heard that this may be the case, that there is a substantial difference.

Dr. MENARD. Most of the reef certainly is Jurassic. You can see that on profiles 4 and 5. I guess profile 4 is the best one to look at for a general sort of picture of what is going on. We find that the reef began somewhere in about the middle of the Jurassic, you would say, and the land kept sinking there, and the reef kept growing up because a reef can grow only where it can get sunlight, so it has to be in very shallow water. Land kept sinking. Sediment accumulated behind it.

Seafloor kept sinking, and all of these things we understand quite well now, but the reef, as you can see, did not stop growing in Jurassic time. It goes above that Jurassic-Cretaceous boundary, so it went into lower Cretaceous rocks.

The most promising Cretaceous rocks are near the top. Indeed, a large number of giant fields in the world are fed by source beds from Cretaceous marine sediments, but the most promising of these sediments are in the upper part of Cretaceous. So to be comparable you would have to visualize not only that the reef went into the Cretaceous but that it went in the uppermost part.

Mr. FORSYTHE. In figure 4, the end quotes, the 65 to 140 is meters. What is MY?

Dr. MENARD. I am sorry, MY is what the geologists now use for million years, so it is 65 to 140 million years old. Those are just years. The depths are off to each side in kilometers or feet.

Mr. FORSYTHE. I have some additional questions, and I will either get back to them after other members have had an opportunity to question you or submit them to you, Dr. Menard.

Thank you, Mr. Chairman, at this point.

The CHAIRMAN. Mr. Livingston.

Mr. LIVINGSTON. Thank you, Mr. Chairman.

Dr. Menard, does or does not industry have the capacity to explore in 6,000 feet of water at this time?

Dr. MENARD. It has the capability; that is, it has not done it but it has equipment that was designed for that. It is the same equipment now drilling at almost 4,800 feet, so I am told by people who have the ships that they are prepared to lease me one right now, if I have the money, that can drill in 6,000 feet.

Mr. LIVINGSTON. So they can do it if they want to. Now they could not produce, though, at 6,000?

Dr. MENARD. There is no equipment at the moment capable of producing.

Mr. LIVINGSTON. And how long do you think that will take, before they get that sort of equipment?

Dr. MENARD. I think especially regarding the equipment designed to operate on the deep sea floor, that by the time you had run through the whole process, if you hit a good strike out there, and had a powerful incentive to go ahead and develop production equipment, that equipment could be modified. It is speculative, but once you go into equipment that operates essentially preflooded, why, it doesn't matter how deep it is.

Mr. LIVINGSTON. So you are saying that right now there is no real incentive to produce that equipment, but if the incentive existed, then it might take, what, 2 or 3 years to develop it?

Dr. MENARD. Yes. Well, I would hesitate to say 2 or 3 years. High technology takes longer than we think, but the equipment that approximates that, and is from what I have seen of it, of the general design to be capable of operating down there exists right now, so it is a matter of increasing capability.

Mr. LIVINGSTON. Now, the success ratio with respect to the Baltimore Canyon has not been too great. I take it you would agree with that?

Dr. MENARD. I certainly would, but it gets better as you go out.

Mr. LIVINGSTON. Do you have an idea how much money was expended in drilling those five holes?

Dr. MENARD. No.

Mr. LIVINGSTON. Quite a bit, though?

Dr. MENARD. \$5 million a hole, something of that sort.

Mr. LIVINGSTON. I guess this is a loaded question: Do you feel on the basis of your testimony, that going further, to a depth of 6,000 feet, without any guarantees that we are going to be successful, that that venture justifies the tremendous expense involved?

Dr. MENARD. Well, I would like to think that the justification would be in the minds of industry, and whether they want to undertake it. Our job, as I feel it, is to identify promising places. It

is industry's job to decide whether it makes any economic sense to go ahead.

Mr. LIVINGSTON. I think that is a good point. Hasn't industry expressed themselves on exactly that with respect to the *Glomar Explorer*? Have they not more or less rejected any implication that they might participate with the Federal Government to spend a lot of money and develop the *Glomar Explorer* so that it could explore in 6,000 feet of water for hydrocarbons?

Dr. MENARD. I am at a disadvantage, gentlemen. It is clear that you have been getting more communication from industry on this issue than I have. As an oceanographer coming into this some several years ago, when the idea first came up, it was just an academic idea, and it was my interpretation at the time that the program would not sell.

It was too expensive to do pure research out in deep water. Well, it has been considerably modified to have a much greater potential economic benefit now, but the fact, as I deduce, that there is more than one conversation with industry or discussion is simply hearsay.

Mr. LIVINGSTON. I understand that there have been three meetings, between Dr. Press and industry, and the industry has indicated that they would go along with the funding of the development of the *Glomar Explorer* for purely scientific research purposes, but not for the development of hydrocarbons. Do you have any information which would confirm that?

Dr. MENARD. Well, no, not on the three meetings. I have heard that one meeting was planned from Dr. Press, whom I see often enough, but I have not talked to him on this issue, and one meeting I heard about from an Exxon official who paid a courtesy call on me, but that is all I know about it.

Mr. LIVINGSTON. Thank you very much, sir.

Dr. MENARD. If they're going to fund it, I am delighted.

Mr. FORSYTHE. Mr. Lewis?

Mr. LEWIS. No questions.

Mr. FORSYTHE. Dr. Menard, just to wrap this up, this question of the *Glomar Explorer*, and we did talk a bit the other day, there has been considerable interest, in utilizing that facility for a number of years. I might add that I share in this interest. It seems to me that one of the things involved here is a concern, that a proposal at least has been discussed, that would lead to Federal exploration. As you well know, there are many of us in Congress who believe that this is really a very poor goal to pursue.

It is your feeling that, if it is going to be a viable operation, it must be connected with a Federal exploration program, which in essence means at the most off-structure drilling.

Dr. MENARD. Mr. Forsythe, I personally believe it is the Government's responsibility, as it has been, to collect information whereby it can reach rational decisions on whatever matters that are of concern. It used to be that the Geological Survey would do broad-scale regional reconnaissance connected with finding minerals, copper, ores, oil, and gas sometimes, and I think that is a legitimate function of Government, in advance of industrial development.

Industry does the development, and I think properly so, not Government, but the Geological Survey is at present, running an

operation, the preliminary exploration of the National Petroleum Reserve in Alaska, and that is done at the direction of Congress, in order to enable the Congress and the President, to make an assessment of the best land use for the area.

So it appears to me there are times when even though everyone agrees—I am not saying everyone does, but even if everyone did agree—that industry would do all the development and Government would do exploration where it appeared in advance of a sensible investment by industry, that there would be times in which Government, in its exploratory role, would be drilling on structures. We are doing that right now in NPRA. I have no desire for the Government to drill anywhere offshore other than for the scientific objectives, which I guess are not comparable. That is industry's role.

The COST drilling modification so you can drill on structure is an option to industry to do that. Certainly if industry wants to go ahead and do it, they do not want to go ahead and do it, they do not have to. But at the same time if one were to discuss theoretical options, there is a theoretical option for the Government to do the same thing. I do not see any point in it, if industry is going to go ahead and do it itself.

Mr. FORSYTHE. On MPR Pet-4, as I understand it, we actually started drilling there in 1944. We are now 25 years without a commercial find. Now it is true that perhaps the first 25 years of that was under a totally different set of circumstances. We did not drill at the depths we do now. It took the technology of Prudhoe Bay to really move into this new kind of development. However, it still is a zero situation in terms of available hydrocarbons that are commercially exploitable, as I understand it.

Congress, of course, has debated this one within the last year, as to what national policy is to be, and the most recent moves, as I understand it, really mandate that we shift away from fuel exploration, and go to leasing and to private exploration, so I do have questions in this area. As I would easily confess, there is a very wide difference of opinion, no matter where you go, I guess, here on the Hill, downtown, and even outside, but I did want to get this kind of comparison on the record. I appreciate your testimony this morning very greatly, and if there are no further questions, the committee will adjourn.

We thank you very much.

[Whereupon, at 10:30 a.m., the select committee adjourned.]





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